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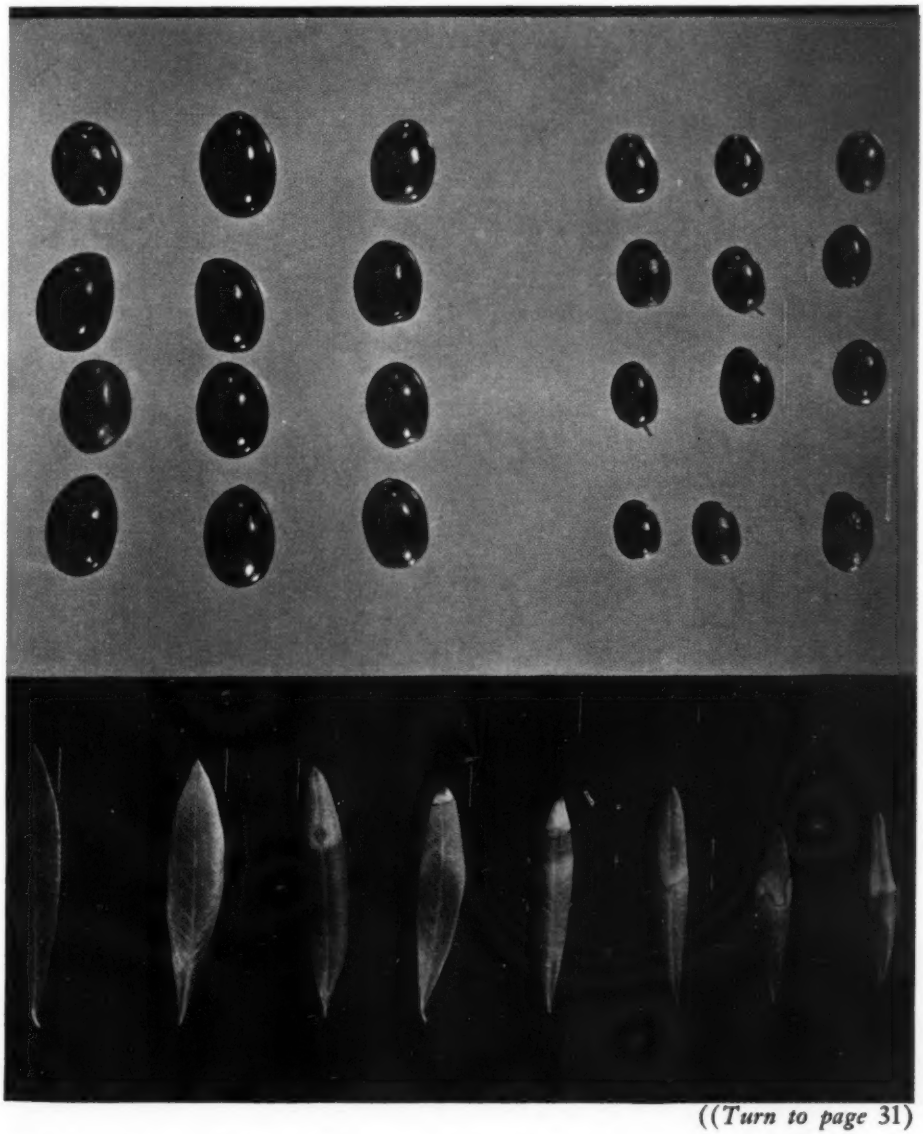

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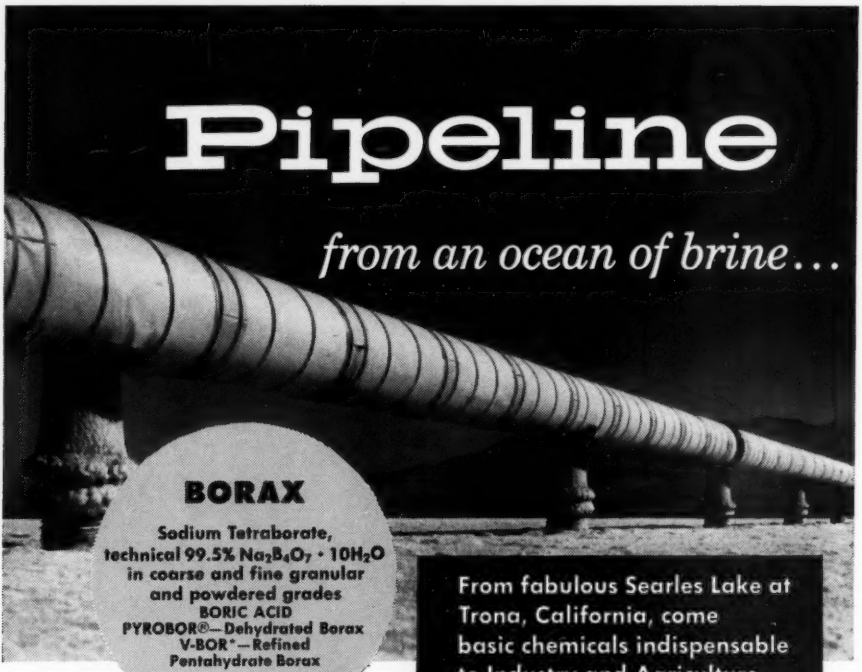

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R. H. STINCHFIELD, *Editor*

Editorial Office: 1102 16th Street, N. W., Washington 6, D. C.

VOLUME XXXIX NO. 9

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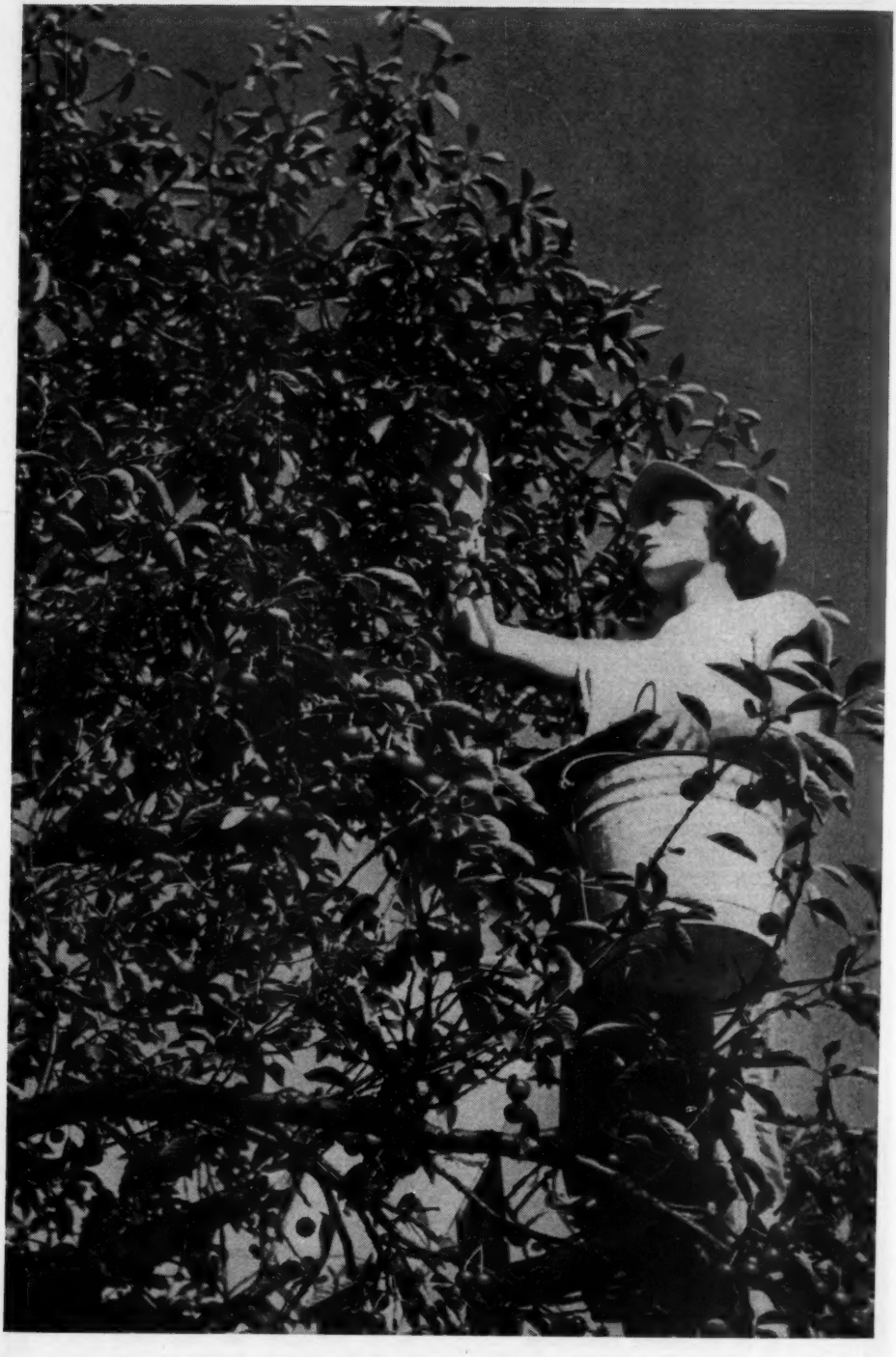

Steadiness Required!

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VOL. XXXIX WASHINGTON, D. C., NOVEMBER, 1955 No. 9

Our Thoughts Go . . .

Rambling at Random

Jeff McDermid

(ELWOOD R. MCINTYRE)

THIS time our thoughts ramble a little and do not follow a direct course through one sustained topic. The reason lies in some incidents and observations that were found to throw new light on the farmer of an earlier day, who dispensed a sort of arbitrary justice in the job as local judge and peace officer, and the wave of agricultural crazes which had so long a run before we had state experiment stations to save the farmer from his own credulity and cupidity. Or, at least try to do so.

Both of these themes have had but sketchy treatment as a rule, although research savants in the social sciences have often found the country "justice of the peace" and the "sucker for gaudy novelties" excellent material for analyses and comment. Not that mere residence in the open country brings about the quirks and peculiarities thus studied—for humanity everywhere under similar circumstances is apt to react and display the same identical traits as the farmer.

Back 50 or 60 years and more ago there were far more country justice trials. At least, there were a greater number of independent thinkers and rather arbitrary local leaders seated on the bench in the backwoods days. Judge Bean "west of the Pecos" is only a type projected into the border from a cult that had thrived and rendered a sort of raw justice during our formative years when farmers shunned books and created their own tenets of both husbandry and law, mostly on the spur of the moment.

In the Midwest where such personal

court decisions were the common rule, most men forgave a little irregularity and judicial domineering for the sake of substantial justice in the long run and a good joke besides. While not partaking entirely of the methods of the vigilantes and the hanging gangs of western lore, our sturdy country justices sometimes reached too far perhaps while trying to go in the right direction.

In 1862 there lived in a Midwest state a fellow named Smedley, who in his actions seemed to be entirely "law proof" as far as the settlement of debts was concerned. He played fast and loose with his financial obligations and was a smart operator. Though there were on record sundry executions and commitments against him, no property could ever be found upon which they could be levied. He was a thorn in the side of the constables and their partners, the local justices.

BUT it happened that a man named White was finally elected the town constable, and he vowed to go after Smedley tooth and nail. He became quite celebrated in a local way for his success and nimble wit and shrewdness on official duties, as well as for the high hand with which he carried his mace of authority.

So it became a public checker game between the dodger and the revenger. But White had caught a Tartar and he found Smedley an artful hound to trace. Whenever he found Smedley in possession of some property, and made a levy, it was taken to court and proved to belong for the moment to "somebody else." The only results of White's first efforts was the addition of more heavy costs to the already hopeless demand.

Finally, however, White learned that Smedley had just traded horses with a man named Wyatt. White posted off at once to his local justice officer. He and the magistrate laid their heads together and agreed upon a mutual plan of operation against the enemy.

First, White levied charges against the horse then in the possession of Smedley. He took him to court on one of two writs. He then levied the second writ upon the horse which Smedley had traded to Wyatt. Poor Wyatt, apprehending the probable loss of his equine property, claimed the first horse—the one he had traded to Smedley. But upon trial of the right of property in the case, the justice solemnly decided that the horse was found in Smedley's possession, and was therefore subject to levy and sale by the court. Accordingly, the horse was sold and the first writ of judgment was satisfied.

The confused Wyatt then claimed the second horse—the animal he had received in trade from Smedley. But upon coming to trial, after severely reprimanding Wyatt for laying claim to both horses, when on his own showing, he never owned but one, the judge decided that the property in dispute had been in the possession of Smedley at the time of the original rendition of the judgment; and was consequently, like the other horse, subject to a lien, and so equally liable for levy and sale.

The horse was sold to satisfy the second writ of execution. The befuddled Wyatt was dismissed by the justice with a gentle admonition to "be henceforth careful with whom he swapped horses." It thus took two horses to settle part of Smedley's outstanding debt, and he could not claim that one of them never belonged to him.

SQUIRE Allen was a plain, honest farmer who had distinguished himself in his community as a pioneer and a man of courage. In 1820, the governor of his state sent him a commission as justice of the peace. Though Allen was none too clear what his duties, dignities, and responsibilities precisely were, he vowed to discharge them to the letter as a sturdy citizen should.

At the period of his appointment, he was having a bristling feud with one

of his neighbors over that most fruitful of all bucolic quarrels—the right division of the line fence. He received his docket, blanks, and legal form book one Saturday evening. He was thus well supplied with all the weapons of his office. He glanced through them with some pride and laid them aside with care.

On the following Monday morning,

he went as usual to his fields, and there, though full of his new dignity in life, he went quietly at work with his team.

He had not been there long when his old and only enemy made his appearance, and opened up on him a volley of abuse and epithets in respect to the boundary fence. During his discourse, the angry neighbor bestowed upon His Honor the Judge, among other expressive titles, the euphonious one, "an old jackass!"

Squire Allen bore the attack calmly enough until it came to that point; and it is likely, had he not been a legal functionary, a fistic battle would have ensued then and there. But it was utterly beneath his newly acquired dignity, thus outraged, to avenge itself by a vulgar brawl. He bethought himself of a much better and more honorable course. So he threw his coat across his arm, and drove the team home.

There he took down his new docket, and upon the first clear page he recorded the case of "The People of the Commonwealth vs. John Braxton" (his enemy). He thereupon entered the following legal judgment: "The defendant in this case, this day, fined ten dollars and costs, for contempt of court, he having called us a jackass."

On the opposite page, succeeding justices noted there was an entry of satisfaction. By this it appears that he forthwith issued an execution upon the judgment, and collected the money!

PRIOR to the advent of the state colleges and experiment stations, considerable enthusiam for new imported animals abounded among farmers. American consuls and many naval officers contributed to this demand by arranging for the importation of draft and driving horses, cattle, sheep, and poultry.

This and the big talk and visionary schemes about western lands and continental canals marked this era as one of speculation and partaking in popular crazes. Strange to say, but the isolated farmer who had no faith in books or free advice was a rampant chaser after rainbows in the dawning skies of the new republic.

On his home acres, he was an avid patron of the stray peddler, the mountebank of sorts, lightning-rod and patent medicine hawkers, water dowsers, and lottery-ticket vendors. But that was somewhat different from the frequency with which farmers rode hobbies and invested in specialties which would make them easy money while the ordinary, unimaginative neighbor stuck tight to his usual rotations and homespun economy.

Such manias, crazes, and fevers were probably natural to the period. First one of any consequence was the craze for Merino sheep from Spain. Eastern farmers fell over each other to get hold of the nucleus of a Merino flock. Prices of imported breeding stock

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A New Day in Peanut Production

By E. T. York

Department of Agronomy, North Carolina State College, Raleigh, North Carolina

APPROXIMATELY four years ago, an article was published in this magazine entitled "Research Points the Way to Higher Levels of Peanut Production." In this article we indicated that peanuts had long been the nemesis of agronomists by having successfully "resisted" attempts at increased production—with average yields remaining essentially unchanged during the past several decades. It was pointed out, however, that research programs were now answering many previously unsolved problems and should pave the way for very significant advances.

This discussion is in the form of a progress report, summarizing some of the advances which have been made in peanut production in North Carolina in recent years. We would also like to consider some new developments which may have further impact upon our peanut program in the future. (Figure 1).

Yields, 1920-1954

We might look first at production figures for North Carolina during the past 35 years. The average yields of peanuts changed very little during the period 1921-1950. In fact, there was little change in peanut yields during the first half of the twentieth century. From 1951 through 1954, however, we have observed very substantial advances, with progressive yield increases of 24, 33, 45 and 55% above the 1941-1950 level. Furthermore, there are no indications that this yield curve is leveling off. In fact, with continuing research programs leading to the development of new varieties and other improved practices, we should expect equally impressive advances in the next five years.

Factors Contributing to Yield Increases

Let us now examine some of the factors which have contributed to the increases in average yields in North Carolina over the past four years. In our earlier article, we discussed various improved production practices which had been developed through research. These practices had been found to exert a marked influence upon yields and have since served as a basis for an all-out educational program.

In 1951 an extension specialist was employed to work full-time in carrying to the farmers this research story. County and community meetings were held throughout the peanut-producing region with members of the research staff frequently joining the extension specialist in telling the story of improved production practices. Demonstrations of these improved practices were carried out throughout the major peanut-producing areas. The "story" found very receptive ears among peanut growers who had in past years observed marked improvements in production practices with corn, tobacco, and most other crops, while peanuts lagged behind. As interest grew, local businessmen and farm organizations sponsored prizes for high production records. The State Legislature appropriated money for a new peanut research station. The "lowly goober" began to come into the spotlight more and more as there evolved a general belief that something could be done to

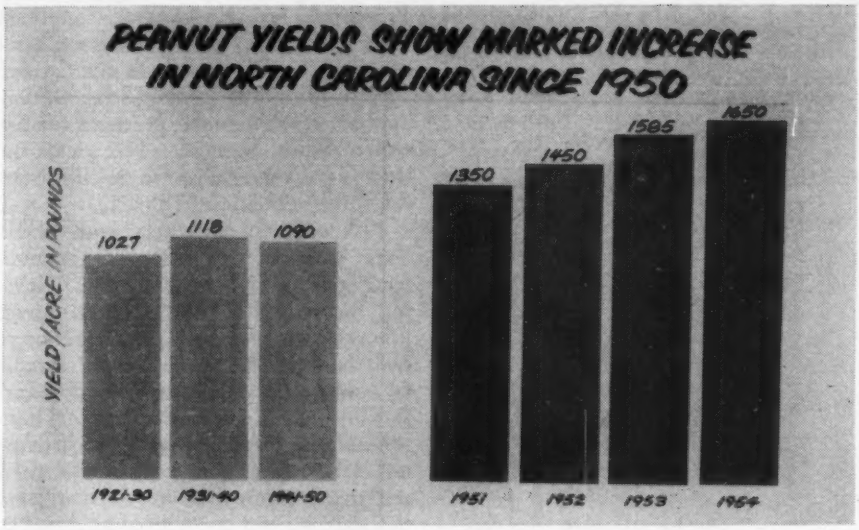

Fig. 1. Peanut yields remained essentially constant during the first half of the 20th century. From 1951-1954, yields increased progressively to a level 55% higher than the 1941-50 average.

improve peanut production.

The experiences of one farmer in Edgecombe County might serve to illustrate what happened to many growers as this story was put into practice. This farmer had a long and consistent record of low production, averaging from 700-800 pounds per acre. He agreed to follow recommended practices and asked that a complete program be planned. In departing from his normal practices, he had his soil tested and broadcast both lime and potash before planting. He planted his peanuts in 24- instead of 36-inch rows to increase his plant population by some 50%. He applied an insecticide at first cultivation for the control of soil-borne pests which frequently damaged his crop. He cultivated the peanuts as flat as possible (using a rotary hoe in early season) to avoid covering up the vines and to give a suitable bed for "pegging." He applied copper-sulfur dust for the control of leaf spot. He also continued the practice of using land plaster at early flowering to supply calcium. The first year these practices were put into effect he averaged 2,350 pounds per acre as compared to a yield of 705 pounds the previous year. Another grower in Moore County likewise increased his yields threefold in going from a yield level of approximately 1,000 pounds to better than 3,000

Fig. 2. An improved strain of peanuts developed by Dr. W. C. Gregory, leader of peanut breeding program. Pictured above is C. Z. McSwain, Superintendent of New Peanut Belt Research Station, Lewiston, N. C.

TABLE I. PEANUTS YIELDS PRODUCED IN FARM-WIDE DEMONSTRATIONS BEFORE AND AFTER IMPROVED PRODUCTION PRACTICES WERE ADOPTED.

County	Field	Year	Yield lbs./Acre
Chowan.....	1	1950	1,450
		1953	2,084
	2	1951	1,300
		1953	2,084
	3	1950	1,400
		1952	1,995
Martin.....	1	1951	590
		1954	1,500
	2	1949	900
		1952	1,500
	3	1950	1,000
		1953	2,200
Pitt.....	1	1949	550
		1952	1,801

pounds the first year he adopted such a complete set of recommended practices.

Several farm-wide demonstrations were established throughout the peanut belt in 1951 in which the farmer agreed to follow a specified rotation and use recommended practices for his entire peanut acreage. The yields on three farms might serve to illustrate the results obtained (Table I).

Although no extremely high yields were obtained the first year peanuts were grown in these rotations following the adoption of certain improved practices, very substantial increases were realized and further advances should be made as the long range rotation and fertility effects are manifest. These few farmers participating in such demonstrations are doing much to help sell many peanut growers throughout the state on the wisdom of adopting a complete set of recommended practices.

Opportunities for Further Advances

Varieties. In 1953 the North Carolina Experiment Station released two new varieties, N.C. 1 and N.C. 2.

(*Turn to page* 48)

Fig. 3. In 1952 an extensive rotation experiment was initiated to determine the most suitable cropping sequences and management practices for peanuts. The above picture shows a part of the several acres devoted to this experiment at Lewiston, N. C.

Rootstock Influence on the Potassium, Calcium, Magnesium Nutrition of Citrus

By A. Wallace and R. L. Smith

University of California, Los Angeles, California

CITRUS trees are usually budded or grafted to a different rootstock species for one or more reasons. These reasons include disease resistance, vigor of growth, compatibility, and tolerance to climate. The rootstock species has a very pronounced influence on many other aspects of the tree. These include differences in fruit quality, time of maturity of fruit, differential fruit yield, and differences in susceptibility to nutrient deficiencies and excesses. It is about this last characteristic that this discussion will be concerned. This subject is of widespread interest because within varieties of other plant species, including deciduous fruit tree rootstocks, there is a wide range of susceptibility to nutrient deficiencies.

Rootstocks and Mineral Nutrition

Citrus rootstocks have been reported to differ in the accumulation of boron by the scion species (9), in susceptibility to lime-induced chlorosis (4), in the tolerance to salinity conditions (3), and in susceptibility to zinc deficiency. The citrus trees in California that have been found with phosphorus deficiency were confined to certain rootstock species (1). The ability of different rootstock species to differentially accumulate the cations, potassium, calcium, and magnesium, has also been reported in recent years (10,15,18).

The data reported from various sections of the United States have been very consistent in which rootstocks accumulate potassium at the expense of calcium and magnesium, and which rootstocks do the reverse. In Table I are data for the influence of several prominent citrus rootstocks on the inorganic composition of the scion species.

The influence on mineral nutrition peculiar to the different rootstocks is of great importance in maintaining proper soil-fertility conditions in citrus orchards. The use of different rootstocks makes simple recommendations difficult, if not impossible, unless the rootstock is known. Since trees in orchards are usually several years old, the nutritional program must be adapted to conform to the rootstock species that are already established. An understanding of the nutritional peculiarities of each species is therefore important in determining the management practice for a given orchard.

Root Cation Exchange Capacity

Studies on this nutritional problem by the Department of Subtropical Horticulture of the University of California at Los Angeles have been confined mostly to developing an understanding of the rootstock influence. Several interesting relationships have been observed and some progress has been made in finding reasons for them. In recent years some workers in the Eastern United States and elsewhere have reported very excellent correlations be-

TABLE I.—THE MEAN INORGANIC COMPOSITION OF SIX-MONTH-OLD LEAVES FROM SEVEN DIFFERENT CITRUS SCIONS EACH BUDDED TO FIVE DIFFERENT ROOTSTOCK SPECIES, ILLUSTRATING MARKED EFFECT OF ROOTSTOCKS ON THE MINERAL NUTRITION OF CITRUS.*

	Percentage of				
	K	Ca	Mg	N	P
Rootstocks—Each with Seven Different Scions					
Rough lemon	1.03	3.68	0.23	2.93	0.108
Sweet orange	1.38	4.02	0.19	2.80	0.113
Grapefruit	1.65	3.99	0.16	2.71	0.114
Sour orange	1.01	4.79	0.18	2.54	0.098
Trifoliate orange	1.30	4.26	0.21	2.70	0.123
L.S.D. at .05	0.21	0.45	0.03	0.18	0.011

* Trees were 21 years old.

tween the cation exchange capacity of a root surface (20) and the ability of plant species to differentially accumulate divalent and monovalent cations (2,6,7, 8,11). It had previously been observed that legumes failed to compete properly with grasses in mixed plantings if the potassium status of the soil was low or relatively low or that certain weeds in that environment could crowd out the legumes (19). The effect of the cation exchange capacity of the root was then later reported and this served as a good procedure for possibly explaining the characteristics of the different plant species. The theory is that root surfaces with a high density of charge, supposedly because of the Donnan equilibrium phenomenon, tend to accumulate divalent cations preferentially to the monovalent cations. In contrast, roots with a low density of charge preferentially absorb the monovalent cations.

To test whether or not this phenomenon may be a factor in the differential uptake of cations by citrus rootstocks, a detailed study has been made of cation exchange capacity of rootstocks commonly used in field plantings (16). A preliminary report on this subject was made previously and the data indicated a relatively good correlation between the rootstock species and their ability to absorb cations (17).

An important part of our studies was an attempt to determine whether or not the cation exchange capacity was the cause or the result of the differential cation uptake. Citrus and other plant species were grown in widely different cation and nitrogen environments so that plants having greatly different mineral composition would be produced. These differences in environmental treatments resulted in very slight to no differences in the cation exchange capacity of root surfaces. The differences that were observed invariably could be assigned to differences in the size of the rootlets. In fact, it appeared that the inherent differences in actual size of the active feeder roots of these plants could seriously complicate the relationships, such that they might be overlooked or that they would be completely impossible of mathematical interpretation.

The values for the cation exchange capacity in me./100 gm. dry roots of different rootstock rootlets that appeared to quite closely represent the species were: rough lemon 30, sweet orange 23, grapefruit 21, and sour orange 25. If the density of charge has an influence on the uptake of cations,

TABLE II.—RATIOS OF THE ROOT CATION EXCHANGE CAPACITY AND POTASSIUM, CALCIUM, AND MAGNESIUM CONTENTS OF THE LEAF MATERIALS DESCRIBED IN TABLE III, ILLUSTRATING THE USE OF THE EQUATION DESCRIBED IN THE TEXT.

Pairs of rootstock species	$\frac{CEC_1}{CEC_2}$	$\frac{K_2}{K_1}$	$\left(\frac{Ca_1}{Ca^2}\right)^2$	$\frac{Mg_1}{Mg_2}$
Rough lemon Sweet orange	1.30	1.16	1.28	1.25
Rough lemon Grapefruit	1.42	1.32	1.35	1.42
Rough lemon Sour orange	1.24	1.06	1.17	1.05
Sweet orange Grapefruit	1.11	1.13	1.04	1.13
Grapefruit Sour orange	.84	.80	.87	.74
Sweet orange Sour orange	.92	.92	.92	.85

then it appeared reasonable that the difference between two species should be in some manner related to the ratio of the cation exchange capacities for the two species. For this reason we undertook to compare those ratios with the ratio of cations between the pairs of species. It should be pointed out that in most cases comparisons were made with a common scion species such as Valencia orange grown on each of the different rootstock species. An excellent relationship was found between the ratio of pairs of exchange capacities with the reciprocal potassium contents in the leaves of the scion species, and also with the square of the ratio of pairs of species of the calcium contents of the scion leaves grown on different rootstock species. In Table II are given some of the values obtained. The values in that table were obtained by calculation of data of Smith, Reuther, and Specht (15) in Florida. Their data were used for this particular table because for all the cations they gave better relationships than any data obtained in California. The data used are in Table III. Reasons for this are easy to understand since in California the calcium content of the soil is usually extremely high—the relationships are more striking when the cation levels in soil are low—and the trees with which we worked were old and had been producing crops with differential yields for many years. The trees used for these analyses in Florida were from soils having sufficiently dilute cation concentrations to allow all relationships to be manifest. This does not mean that these relationships do not hold in California. Striking relationships between potassium and magnesium leaf contents in the University of California at Los Angeles orchard will be described later.

The following equation can be used with a certain degree of assurance in predicting the relative influences of two

TABLE III.—CATION EXCHANGE CAPACITY OF ROOTLETS OF FIELD SAMPLES FROM U.C.L.A. OF FOUR CITRUS ROOTSTOCK SPECIES AND POTASSIUM, CALCIUM, AND MAGNESIUM CONTENTS OF VALENCIA ORANGE LEAVES GROWN ON DIFFERENT ROOTSTOCKS IN FLORIDA FROM THE DATA OF SMITH, ET AL. (15). THE RATIOS IN TABLE II WERE CALCULATED.

Rootstock species	Cation exchange capacity me./100 g. dry weight	Per cent of dry weight		
		K	Ca	Mg
Rough lemon	30	1.98	2.44	.514
Sweet orange	23	2.30	2.16	.408
Grapefruit	21	2.62	2.11	.369
Sour orange	25	2.11	2.26	.488

different rootstocks on cation uptake:

$$\frac{CEC_1}{CEC_2}=\left(\frac{Ca_1}{Ca_2}\right)^2=\frac{K_2}{K_1}$$

The term CEC_1 is the cation exchange capacity of one species and the Ca_1 and K_1 are the calcium and potassium concentrations, usually of leaves, of the same species. The reason that the ratio of calcium concentration appears as the square comes from the theory on Donnan equilibrium which is a relatively simple chemical relationship. Each calcium ion carries two electrical charges. The correlation between the observed and predicted values in Table II is excellent. Considering the possible difficulties which can lead to error, such as differential distribution of nutrients among plant parts, differential fruit removal, differences in tree sizes which might result in concentration and dilution of nutrients, errors in measurement of the exchange capacities and of the cation contents, differences in the size of roots of different species, and different levels of cations available in the soil, these values are indeed remarkable. Of course, it is absolutely necessary for the two plants compared to be grown in exactly similar soil.

Some individuals have raised an objection that it is perhaps not justifiable to compare as a ratio one plant species with another. It must be admitted, however, that these comparisons are made with very closely related species and with a single species as a scion, and for these reasons are probably justified. Using the same equation, however, to compare widely different plant species does give very similar results in many instances. Calculations for some other plant species by the same method, using data of other workers, are in Table IV. Again there is an excellent relationship between the ratios of cation exchange capacities and the appropriate ratios of the cation contents. The error sources with widely differing species are even greater than for the closely related species. Different kinds of foliage with different amounts of structural substances in them could cause ratios to be very erroneous.

Magnesium

There have been some cases of magnesium deficiency in California citrus orchards. The data on the influence of rootstock on cation uptake do indicate that rootstock species could have considerable influence on magnesium deficiency. McColloch and Bingham* have recently found relationships between the soil content of cations and the development of magnesium deficiency in citrus. Several years ago we noticed a borderline magnesium condition in citrus leaves in the University of California at Los Angeles orchard. The magnesium content of leaves of trees grown upon the grapefruit rootstock gave the lowest magnesium contents of all trees in the orchard, and recently some magnesium deficiency symptoms have appeared on some of those trees. The soil area where the symptoms appeared has received liberal quantities of barnyard manure during the past 25 years. This has resulted in a slight accumulation of potassium relative to magnesium, such that the two are present in the soil in almost equal concentrations in the exchangeable form. The surface seven inches of soil contained 2.0, 20.0, and 2.0 m.e. per 100 grams, respectively, of potassium, calcium, and magnesium. From seven to fifteen inches the values were 1.5, 20.8, and 2.5, respectively.

How magnesium will fit into the equation given above relating root cation exchange capacity to nutrient content of leaves is important. In the data of Table II, the best ratio data that fit with the other data were found to be that of comparing the ratio of magnesium in one plant to that in the other. This gave almost the same values as did the ratio of the cation exchange capacities. The data were included in Table II. Why this does not require

* Private communication with R. McColloch and F. T. Bingham, Citrus Experiment Station, Riverside, California.

TABLE IV.—RATIOS CALCULATED FROM VALUES OBTAINED FROM THE LITERATURE FOR ROOT CATION EXCHANGE CAPACITY AND CATION CONTENT OF VARIOUS PLANT PARTS BETWEEN PAIRS OF PLANT SPECIES, ILLUSTRATING THAT FOR VARIOUS PAIRS OF PLANT SPECIES THE RATIOS IN THE EQUATION APPLY VERY WELL WHEN THE CATION STATUS OF THE SOIL IS LOW.

Pairs of plant species	$\frac{CEC_1}{CEC_2}$ of roots	K supply	$\frac{K_2}{K_1}$	Reference
	Ratio			
Oats/barley	1.85	low	1.61	Drake (6)
"	"	medium	1.12	"
"	"	high	0.92	"
Oats/wheat	2.50	low	2.77	"
"	"	medium	1.56	"
"	"	high	1.07	"
Barley/wheat	1.36	low	1.75	"
"	"	medium	1.36	"
"	"	high	1.17	"
Ladino clover bent grass	2.70	low	2.63	Gray et al. (8)
Ladino clover blue grass	2.04	low	1.85	"
Bent grass blue grass	0.76	low	0.71	"
Ladino clover alfalfa	0.98	medium	0.97	Blazer and Brady (2)
Kentucky blue grass white clover	0.50	low	0.40	"
Peas/oats	4.03		2.94	Mattson (11)
		Ca supply	$\left(\frac{Ca_1}{Ca_2}\right)^2$	
Peas/barley	3.09	high	6.35	Elgabaly and Wiklander (7)
"	"	medium	5.80	"
"	"	low	4.54	"
Peas/oats	4.03		8.18	Mattson (11)
Chenopodium album Lactuca scariola	0.39	high	0.54	Smith (16)
Chenopodium album Hordeum jubatum	1.02	high	1.00	"

the use of the square, if true, as did the ratio of the calcium values is difficult to understand. This could be evidence for a different mechanism of binding by plant roots for the two elements, or it could mean inaccuracies in the general theory of the relationship. If these data are correct, it appears that the following equation might be of value in predicting the magnesium content of plants or some plant parts having roots of different cation exchange capacities.

$$\frac{CEC_1}{CEC_2} = \frac{Mg_1}{Mg_2}$$

The magnesium status of the trees in the orchard at the University of California at Los Angeles was referred to previously. It was indicated above that comparisons using the equation presented could be of value for predicting magnesium needs under California conditions. In Table V are given data for the potassium and magnesium contents of one-year-old leaves of some trees in the University of California at Los Angeles orchard grown upon two different rootstock species. These trees include rootstock species that would be very susceptible to magnesium deficiency or potassium excess, and also rootstocks very susceptible to potassium deficiency and calcium or magnesium excess. Although the ratios for magnesium and also for the root cation exchange capacity for pairs of species very closely resemble each other according to the equation given above, the ratios for the squares also compare reasonably well. In Table VI are additional data for 2½-month-old citrus leaves. For these data the square of the magnesium ratios corresponds with the cation ratios almost as well as does the ratio. They do indicate the very marked influence of rootstock species on potassium and magnesium nutrition of the scion species.

Possibly it would be relatively easy to destroy these relationships by merely manipulating the concentrations of potassium, calcium, or magnesium supplied to the soil such that the equation would be impossible of having meaning. The equations are probably in too simple a form to express a wide range of conditions, but even so are likely a step forward in the evaluation of the nutrient content of plants.

Scion Influences

A complete understanding of all factors entering into differential nutrition of plants must await further studies for their elucidation. There is much yet that is not known. The use of the cation exchange capacity of roots explains rootstock effect on cation uptake, but it cannot explain the effect a scion species has on the cation uptake by plants. Our studies have indicated that a rootstock species has exactly the same influence, at least for some elements, when used as a scion that it had when used as a rootstock. For example, a grapefruit scion on a grapefruit rootstock produces grapefruit leaves having the highest potassium contents of all

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TABLE V.—POTASSIUM AND MAGNESIUM CONTENTS OF ONE-YEAR-OLD LEAVES OF DIFFERENT CITRUS SPECIES, EACH 29 YEARS OLD, GROWN ON ROUGH LEMON AND ALSO ON GRAPEFRUIT ROOTSTOCKS AND RATIOS BETWEEN THE TWO ROOTSTOCKS.

Scion species	K content		K ratio *grapefruit* rough lemon	Mg content		Mg ratio rough *lemon* grapefruit	Mg ratio squared
	Rough lemon rootstock	Grapefruit rootstock		Rough lemon rootstock	Grapefruit rootstock		
	%	%	ratio*	%	%	ratio*	ratio*
On own roots	1.03	1.68	1.63	.23	.18	1.28	1.64
Dancy tangerine	0.93	1.34	1.45	.20	.15	1.33	1.77
Rough lemon	0.65	1.17	1.82	.25	.17	1.47	2.16
Grapefruit	1.26	1.99	1.58	.23	.16	1.44	2.07
Valencia orange	0.92	1.35	1.46	.18	.13	1.38	1.91
Averages	.....	.....	1.59	.....	.....	1.38	1.91

* $\frac{\text{CEC (rough lemon)}}{\text{CEC (grapefruit)}} = 1.42$

More Efficient Fertilizer Use by New England Farmers

By R. A. Struchtemeyer

Department of Agronomy, Maine Agricultural Experiment Station, Orono, Maine

WITHIN recent years there has been an ever-increasing amount of talk about the growing population in the United States. Many people recently have been popularizing the fifth plate idea. That is to say, authorities are advocating by 1975 a fifth plate for every four now in existence. Some months back the New York Sunday Times pointed out that since 1950 our population in these United States has increased 5,672,000 persons. As our population increases, the farmer's role in human survival becomes greater and greater.

Statistics (1) show that every year there are fewer real farmers left to produce the food needed than there were the year before. In the past, the farmer's ability to produce has more than kept pace with the decrease in farmer numbers. How long can this continue? Scientists, of course, are willing to stake their futures on the possibilities that they can continue to find new horizons of production and, thereby, continue to increase the farmer's ability to produce more food. The new horizons are becoming more difficult to find so that progress in the future may be somewhat slower than it has been in the past.

If the pressure for food becomes great in the years ahead, New England with its many acres of woods stands to be a vital factor or safety valve for food production. Soil surveys show that there are quite a few acres of land in the New England States that have as high a productive capacity as those now being farmed. It is possible that sometime in the future there may be a second frontier in this area.

Since New England represents an area longer in cultivation than any other area in the United States and at the same time represents an area of very low native fertility, the yields that are being obtained by many farmers in this area are something to be proud of. Potato, corn, grain, and forage yields obtained in this area are as good as, and in some cases better than, those being produced elsewhere. How is this being done? Actually many things enter into the over-all production picture, but certainly the high per-acre rates of fertilization have been instrumental in this achievement.

Realizing that the area must continue to forge ahead and that one way it can do this is by the more efficient utilization of fertilizer, it becomes imperative for one to examine what has happened to our New England soils as a result of our continued application of rather large amounts of fertilizer. Here again a mature agriculture has provided an abundant supply of data on fertilizer usage and the effects fertilizers and cropping have had on the fertility of New England soils.

Again, before examining the data on what has happened to the fertility level of our soils, let's remember that they are naturally low in fertility, high in acidity, generally of illite type clays, commonly sandy in texture, and responsive to fertilization. As a result of these characteristics certain crops have adapted themselves to the area and cer-

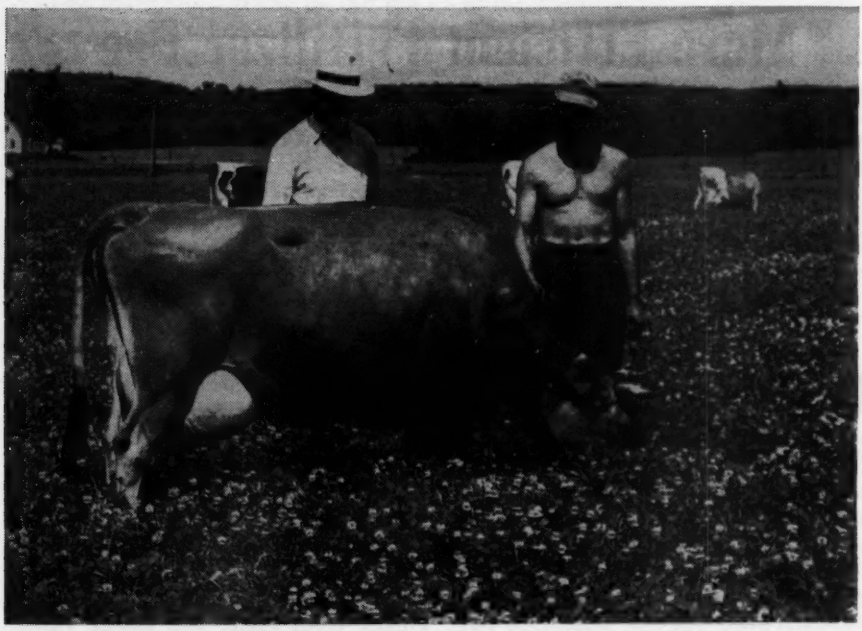

Fig. 1. A brome grass-ladino stand being produced on land with a pH of 6.2 and receiving an annual topdressing of 700 pounds of 0-10-20 fertilizer per acre.

tain management practices have become established.

When considering the fertility status of the soil, it is well to remember that it is ever-changing. There are nutrients being removed from the soil by harvesting of crops, leaching of rain water, and erosion. To offset this downward trend in soil fertility, nature provides some new plant nutrients through the weathering of rocks and minerals and through substances carried down by rain. These natural additions when compared to the quantities being lost while the land is being farmed are mere drops in the bucket. Therefore, it is left to the farmer to balance the account. He can partially replenish the nutrient supply through the utilization of animal manures and green manures, but he must depend very heavily on fertilizer and lime if he is actually going to accomplish his goal.

Let us now examine for just a moment the situation that exists in this area in regard to the removal of plant nutrients from the soil by crops and livestock products. First, the removal by plants has been estimated as indicated in Table I. The removal by livestock products sold off the farm is also indicated in this Table.

TABLE I. NUTRIENT REMOVAL BY CROPS AND LIVESTOCK FOR 1948 EXPRESSED IN TONS (3)

	Crops	Livestock	Total
N.....	108,629	17,889	136,518
P_2O_5.....	30,607	7,595	38,202
K_2O.....	126,413	3,348	129,761
CaO.....	55,405	12,397	67,802
MgO.....	24,348	606	24,954
SO_3.....	28,514	2,371	30,895

From these figures one can see that potash is the material removed from the soil in the greatest amount and that N, P_2O_5, and K_2O were removed in the ratio of 1-0.28-1.16. Some of the secondary mineral elements were utilized to as great an extent as P_2O_5. The crop removal figures plus the removal through livestock products give

some idea of the job that needs to be done annually, and this isn't the whole job. Nutrients are also lost in this area through leaching and erosion.

Since New England soils are not fertile to start with, fertilizer usage has been prominent in the agricultural areas for about a century. As an example, the fertilizer tonnage used in Maine has developed from a very small tonnage in 1850 to 211,485 tons for the year ending June 30, 1953. Figures for the New England States show an increase from 93,000 tons of commercial fertilizer in 1890 to 485,754 tons in 1952.

This long-time usage of relatively large amounts of fertilizer along with other management practices has meant that some fertilizer materials are being accumulated in some soils. A summary of all the removal and addition figures shows that the replacement on a percentage basis has been approximately 155% for N, 255% for P_2O_5, 63% for K_2O, 47% for CaO, 34% for MgO, and 87% for SO_3. Thus it appears that while the fertility status of the plowable land as a whole in New England is improving in the case of some nutrients, others, namely potassium, calcium, and magnesium, still continue to fall behind.

TABLE II. COMPOSITION OF CARIBOU LOAM (2)

	Virgin soil	Cultivated soil
Readily soluble P_2O_5..	44#/A	192#/A
Exchangeable K_2O....	76#/A	398#/A
Organic matter.....	5.70%	5.36%
pH.....	5.09	5.24

Where does all of this lead us in regard to fertilizer usage in New England? Let us take the situation in Maine as an example. Many of Maine's potato farmers have been applying more fertilizer to their potato fields than they could possibly utilize at the present yield levels. This should mean an accumulation of some of the nutrients. That is exactly what has happened. Table II shows what has hap-

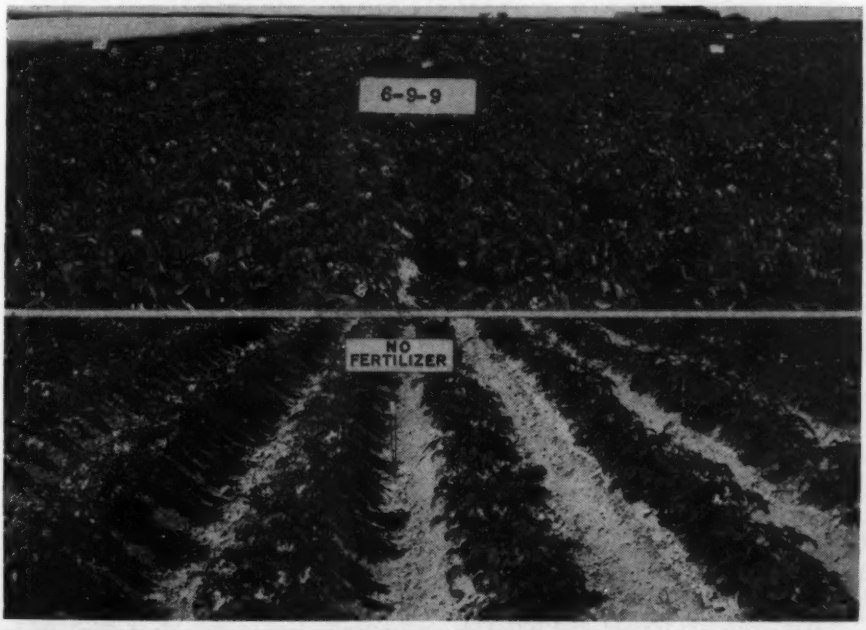

Fig. 2. Comparison of top growth produced by potatoes having received a ton of 6-9-9 fertilizer and those receiving no fertilizer.

pened to Caribou loam that has been frequently cropped to potatoes.

As can be noted from Table II there has been an appreciable accumulation of P_2O_5 and K_2O. As a result of these findings and other research results concerning the amount of nutrients utilized by potatoes at certain yield levels, the potato farmers are being encouraged to use 120-150 pounds of N, 180 pounds of P_2O_5, and 180 pounds of K_2O per acre where the soil test for P_2O_5 and K_2O shows a medium to high test (4). These recommended amounts are considerably less than many farmers are now using. Therefore, it might appear that the use of less fertilizer is being advocated in Maine.

The idea of using less fertilizer in Maine or any other New England State is not what is desired, but the thing that needs to be done is to see that the fertilizer is put on the soils and the crops where it will do the most good. All the crops in Maine, with the exception of potatoes and possibly vegetables, could stand considerably more fertilizer than they are now receiving. The chance for greatest returns on the fertilizer dollar in Maine and most of New England is on forage crops. Forages as in Figure 1 mean dollars saved by the farmer on his feed bill.

Having considered some of the general aspects of this whole problem, how can the fertility situation on individual farms be improved? First of all, I would like to point out that there is a lot of room for improving the soil-testing program. Personally, I would like to see the time come when every pound of fertilizer is applied on the basis of a soil test. This situation becomes a necessity if prescription writing for specific crops is to succeed. Prescription writing is being carried out very successfully in other areas of the United States. Prescriptions are now actually being written for 100- or 125-bushel corn crops with good results.

Along with soil testing and fertilization goes the matter of liming. Actually, the fertilizer people have a big stake in the use of lime if they are interested in the most efficient use of the fertilizer they sell. Too many fertilizer people fail to give lime its full credit in crop production and rather look at it simply as a competitor for the farmer's dollar. This is certainly a shortsighted attitude.

Regardless of what the attitude may be, the lime picture is a very alarming one. In Maine the use of lime hit a peak in 1946 when 102,000 tons were used. The figure for 1953 stands at roughly 55,000 tons and the 1954 figure shows a further drop. These figures are particularly alarming when one realizes that farmers in Maine should be using at least 200,000 tons of lime a year. This situation is not restricted to Maine but holds for all the New England States. Everyone connected with agriculture should help in reversing this trend away from the use of lime.

Last but not least, more efficient fertilizer usage will be possible when fertilizer is applied to the soils on the basis of soil types. Much of the New England area has been covered by soil surveys, but very little fundamental information on these soils has been gathered. However, we are rapidly becoming aware of soil type differences in regard to response to fertilization. Many people feel that it is impossible to reach maximum efficiency in fertilizer usage until all of the soil resources have been classified and fertilizer response data on them collected.

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Fig. 1. Using highly productive soils or making generous applications of fertilizer containing nitrogen helps to assure a good protein content in the corn crop. On poor soils fertilizer treatment causes increases in the protein content of the leaf-stalk portion of the forage as well as large increases in yield. Left, unfertilized; right, fertilized.

High-protein Corn May Help to Solve Feeding Problems[1]

By W. B. Nevens

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THE protein content of corn can be stepped up, thus bringing an increase in its nutritive value. This has been amply demonstrated in recent experiments. Nearly 3 billion bushels of corn are grown annually in the United States and 85 to 90% of this is fed to livestock. An increase in protein content of the crop would lessen the need for protein supplements, reducing labor as well as cash outlay for feed.

Insufficient protein in the ration is still a limiting factor in the production of meat, milk, and wool. Emphasis on vitamins, trace minerals, and more recently on hormones, has tended to obscure the need for adequate amounts of protein. Too little protein limits the rate of gain and amount of milk produced. This basic fact in nutrition must not be overlooked.

Why are protein supplements employed? Rations consisting of grass pastures, grass hay or grass-legume hay, corn silage, and farm grains which are chiefly corn are so low in protein content that too much grain must be fed when there is no other source of protein. When attempts are made to complete the protein requirements of high-producing ani-

[1] (This article is largely based upon Bulletin 586, "High-protein Corn as a Source of Protein for Dairy Cows," published by the Illinois Agricultural Experiment Station. The bulletin was prepared by W. B. Nevens, K. E. Harshbarger, G. H. Rollins, K. E. Gardner, and K. A. Kendall.)

mals, e.g., dairy cows, by feeding more of the farm grains, roughage consumption is lessened. This is undesirable since roughages are usually cheaper than grain as sources of nutrients and they also provide more minerals and vitamins. Under normal price conditions, an economical way of supplying extra protein is to mix a protein supplement with the grain. In some areas, particularly grain-importing regions such as the North Atlantic States, the use of protein supplements is highly favored because of little or no difference in the prices of grains and protein feeds.

Corn a Big Protein Crop

Corn produces more protein than any other United States grain crop. To supply an amount of protein equal to that in the entire corn crop would require 17 million tons of soybean meal. This is about three times the quantity of soybean meal produced annually. Barley furnishes as much protein as 1.5 million tons of soybean meal, oats 5 million tons, sorghum grain 0.5 million ton, and wheat 11 million tons. Unfortunately, the protein content of the grain of most corn hybrids is around 8 to 9%, a figure too low for best results in feeding, as discussed above. On soils depleted of fertility, the protein content may fall to 7%; while on soils supplied with ample amounts of available plant food, the percentage may rise to 10 or even 11%.

Let's put some of these figures on a farm basis. Suppose, as suggested above, that a highly fertile soil makes possible the growing of corn containing 10% protein on land that has previously produced only 8% protein corn. The extra protein in the 10% corn compared with the 8% would be 1.12 pounds per bushel, or 112 pounds for each 100 bushels of corn fed. If soybean meal were being purchased to supply 112 pounds of protein, 250 pounds of the meal would be needed; and with meal at $90 a ton, the cash outlay would be $11.25. In addition to extra protein, higher yields of grain are also obtained from fertile soils.

Will Fertilizers Make High-protein Corn?

Will soil fertilization increase the protein content of corn as it usually does in the case of grass pastures?

Fig. 2. More than 50 years of patient and careful work went into the development of Illinois high-protein corn, the grain of which contains from 16 to 20% protein. Ordinary corn has 8 to 9% protein.

Numerous experiments to test this point have been carried out. One such trial in the growing of silage corn was conducted over a 5-year period at the University of Illinois. The results of the trial are given in an article entitled, "Fertilizers Increase Yield and Protein Content of Corn Forage in Illinois," which was published in the November 1954 issue of this magazine. In that report it was pointed out that the application of fertilizers to highly productive soils already well supplied with plant food brought only small increases in yields of forage and no increases in the protein content of the shelled corn. On the other hand, when the crop was grown on a soil which had become impoverished through long-continued cropping without replenishment of plant food, there were significant differences between yields of the unfertilized and fertilized plots. As a result of fertilization, forage yields were increased about 35% and there was a marked rise in the protein content of the leaf-stalk part of the forage. In one year the protein in the shelled corn from the fertilized plots was much higher than in corn from the unfertilized plots but in another year there was no such rise. It appears from these results that suitable seasonal conditions must accompany soil treatment to bring about an increase in protein level.

In a "good corn year," that is, when rainfall, temperature, relative humidity, hours of sunshine, and other environmental factors are suitable for corn production, the crop may respond to increments of fertilizer in both yield and protein content, judging from the work of E. B. Earley of the Illinois Experiment Station. Professor Earley reports results from central Illinois plots which were treated with 900 pounds of 0-12-12 spread on the surface and disked into the soil. Supplemental applications of nitrogen, as ammonium nitrate, were made at rates of 0 lb., 40 lb., 80 lb., and 160 lb. per acre drilled 4 inches deep with a grain drill. Across these nitrogen plots corn stands were obtained at the rate of 3,920, 7,841, 11,761, 15,682, and 23,522 plants per acre.

The principal conclusions from this experiment which was conducted during a very favorable season, were: (1) For each rate of planting, the yield of grain and percentage of protein in the grain increased as the soil nitrogen increased; (2) on each level of soil

Fig. 3. At the left is a commercial strain of high-protein corn which yields nearly as much forage as a good Corn Belt hybrid, U. S. 13, at right. Compare with Fig. 2 for height of plants.

TABLE I.—YIELDS AND PROTEIN VALUES OF CORN GROWN FOR SILAGE

Kind of corn	Dry-matter content as harvested for silage %	Acre yield of forage		Protein	
		Fresh basis tons	Dry basis tons	In dry matter %	Yield per acre lb.
1950					
U. S. Hybrid 13	25.0	19.7	4.9	9.7	950
Illinois High-protein	25.0	13.8	3.4	12.6	810
High-protein corn C	26.3	17.0	4.5	10.2	910
1951					
U. S. Hybrid 13	29.5	20.4	6.0	9.0	1,080
Illinois High-protein	28.2	15.4	4.4	11.6	1,010
High-protein corn C	27.8	19.2	5.3	9.8	990
1952					
U. S. Hybrid 13	31.9	17.5	5.6	9.4	1,050
Illinois High-protein	25.0	13.1	3.3	13.0	850
High-protein corn C	29.5	18.1	5.3	9.7	1,040
High-protein corn D	29.5	17.2	5.1	10.5	1,060
High-protein corn E	27.2	15.5	4.2	11.7	990
1953					
U. S. Hybrid 13	35.3	15.0	5.3	9.7	1,020
Illinois High-protein	35.1	11.2	3.9	11.8	931
High-protein corn C	31.5	13.5	4.3	9.8	840
High-protein corn D	38.6	10.5	4.0	10.3	830

nitrogen the yield of grain increased but the percentage of protein in the grain (with few exceptions) declined as the planting rate was stepped up. The decline in the percentage of protein was smallest with the heaviest nitrogen treatment. With 11,761 plants per acre, a common rate of planting in the Corn Belt, the yields from the above treatments were 89, 105, 117, and 127 bushels per acre, respectively. The corresponding protein values (dry basis) were 8.1%, 9.1%, 9.4%, and 10.4%, respectively.

High-protein Strains of Corn Show Promise

Ample supplies of plant food aid the corn crop in reaching the full protein content of which it is capable, but cannot carry the protein percentage above this. A possibility of producing corn with higher than the usual percentage of protein does exist, however, and this possibility is through the use of strains of corn which have been bred for high-protein content.

In 1896 workers at the Illinois Experiment Station began selecting corn for high- and low-protein content. The foundation stock was an open-pollinated white dent corn having a protein content of 10.9%. After 50 years of carefully conducted experiments, the average protein content of "High-protein," as it was named, was 19.5% and that of "Low-protein" was 4.9%. In selecting for these extreme differences, attention was centered on the principal objective of the research with the result that grain yields of Illinois High-protein are now only one half to two thirds as high as those of the best hybrids.

Recognizing the possibilities of corn having a high-protein content, plant breeders of several hybrid corn com-

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Zinc Deficiency of Corn in Tennessee*

By Eric Winters and W. L. Parks

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SEVERAL farmers and county agents reported stunted and chlorotic corn in Middle Tennessee in 1948. Field observations of the affected plants were made on a number of different farms. The symptoms somewhat resembled those reported in the literature as being due to a deficiency of magnesium. However, applications of magnesium sulfate in selected areas had no beneficial effect in any case. Exchangeable Mg was determined on soil samples from several cornfields. The amounts found exceeded 200#/A, which is above the adequate level for corn. Treatment with zinc sulfate the following season at a number of locations corrected the difficulty.

Zinc deficiency on corn has been observed most frequently on soils naturally high in phosphate, such as the Maury and Armour of the Central Basin (Bluegrass) area of Tennessee. Symptoms are most pronounced where heavy applications of limestone have been made on the high phosphate soils. Zinc deficiency is observed less often in other soil regions of Tennessee and seems to be associated with liberal applications of phosphate and heavy liming. Soil samples have been collected from many of the fields in which these deficiency symptoms on corn have been observed. The available phosphate by quick test varied from high to medium-high, and the pH as determined by the glass electrode was 6.3 or above in each case. The soil series most commonly involved outside of the Central Basin area are the Hartsells and Tilsit of the Cumberland Plateau and the Dickson, Mountview, and Lawrence of the Highland Rim. All these soils are from siliceous parent materials and are highly weathered. No chemical analysis for total zinc has been made on any soil samples from affected fields, but it seems probable that such soils as the Hartsells and Dickson would be lower in all nutrients than the associated soils from less siliceous parent material.

The sequence of development of zinc-deficiency symptoms on corn is characteristic. A few days after emergence, the second leaves will show a yellow streaking. As the plant grows older, the chlorosis becomes definitely interveinal and appears as a white to yellow striping. At this stage, the tips, margins, and sheaths of the older leaves begin to develop a purplish color. The plants affected will be smaller in size (both tops and roots) than normal plants of the same age. (See Figs. 1 and 2.) If the deficiency is severe, new upper leaves show extremely pronounced chlorosis and the older leaves, now definitely purple, begin to die and turn brown. The entire plant then may die or, if it survives, will show severe stunting and be barren. If deficiency is moderate to slight, only the lower leaves of the plant may be affected, and new upper leaves will develop normally. The purple color is less pronounced in such cases, and stunting of growth may hardly be noticeable by tasseling time.

If stalks of corn plants showing zinc-

* The work reported herein was supported in part by a grant from the Tennessee Corporation.

deficiency symptoms on the leaves are split down the middle, the lower nodes will show a dark purplish discoloration. In general, the more severe the leaf symptoms, the more pronounced are these nodal discolorations. This discoloration is almost black in severe cases.

In cold wet seasons, zinc deficiency of corn seems to be more extensive and more severe than in seasons when the weather at planting time is more favorable. Thus, corn in the same field may show zinc-deficiency symptoms one year and not the next.

Replicated field experiments were initiated in 1951 to study the response of corn to zinc applied at different rates and in different ways. Areas on which farmers had indicated corn chlorosis had been observed in previous years were selected. Rates of zinc sulfate mono-hydrate ranged from 5 to 30 pounds per acre, equivalent to 1.8 to 10.8 pounds of zinc per acre. In the majority of experiments the zinc sulfate was mixed with nitrogen and potash fertilizers and applied in the row or in bands at planting time. In a few experiments, zinc sulfate was applied as a sidedressing to the corn after the leaves had developed definite chlorosis. Spray applications of zinc sulphate (5#/100 gallon) also were used on chlorotic corn in a few experiments. The major results of these field experiments are discussed briefly in the following paragraphs.

In 1951, 10# of zinc sulfate per acre gave approximately the same corn yields as did 30# of zinc sulfate. Both rates when applied at planting prevented appearance of deficiency symptoms in most experiments, though occasionally early in the season there were a few symptoms in plots treated at the lower rate. It would appear that 10# per acre were adequate under the conditions studied. The data in Table I from an experiment conducted in 1954 support this conclusion. Alabama recommends from 6 to 11 pounds of zinc sulfate per acre for corn on zinc-deficient soils of that State.

Sidedressings of zinc sulfate were generally of little benefit to corn showing deficiency symptoms. The reason may be related to limited or delayed uptake of zinc by the roots. It is doubtful if a surface application would be readily available to the roots, particularly if the surface soil were dry. Mixing the topdressing in the upper soil layer would delay uptake by de-

Fig. 1. Tall corn received 20# $ZnSO_4 \cdot H_2O$ per acre banded near the row. Short corn received no zinc, but the same amounts of N, P, and K as did the tall corn.

Fig. 2. Root development of corn plants showing varying degrees of zinc-deficiency symptoms on leaves. Left—no leaf symptoms; right—severe leaf symptoms.

stroying the roots nearby, and new roots could not develop there until after a rain.

Spray applications did increase corn yields, but to a lesser degree than soil applications at planting. The chlorotic leaves seemed to be injured by the spray and often died, though the new leaves that did emerge were not chlorotic. In general, normal leaves did not show any spray injury. Of the methods used in these studies, soil application near or in the row at planting time was the most satisfactory method of fertilizing corn with zinc.

Zinc deficiency of corn has been brought about on experimental areas by heavy applications of limestone on soils high in phosphate. In one experiment on a Maury soil of pH 7.0 limestone was applied at rates up to 5 tons per acre, and the severity of zinc deficiency increased with the increasing rates of liming. In the same experiment, dolomite, a by-product from a zinc-mining operation, was also used as a liming material. The dolomite did not cause the development of zinc deficiencies as did the calcitic liming material used. This may be due to a small content of zinc in the dolomite, approximately 3# per ton.

TABLE I.—CORN YIELDS AS AFFECTED BY ZINC FERTILIZATION

Treatment	Zinc Equiv. lbs/A	Yield bu/A
Check.....	0	7.5
5 lbs. $ZnSO_4 \cdot H_2O$/A...	1.8	27.6
10 lbs. $ZnSO_4 \cdot H_2O$/A..	3.6	36.1
20 lbs. $ZnSO_4 \cdot H_2O$/A..	7.2	35.9
L.S.D. 5%.....		9.1

Hartsells loam
pH 6.4; available phosphate—high

Under conditions of mild deficiencies, corn tends to grow out of zinc deficiencies. It is only where deficiencies are severe that stand and yields are seriously reduced. Only about half the field experiments conducted from 1951 through 1954 showed a significant corn yield response to zinc. It must be remembered that these experimental areas were chosen because of a supposed zinc-deficiency history.

Spontaneous recovery of corn from zinc deficiencies may be related to sev-

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Missouri Near Top in Fertilizer Use

By O. T. Coleman

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DURING the past 16-year period, fertilizer consumption in the U. S. almost tripled. But since the first three county-soil-testing laboratories were set up in 1946, the use of fertilizer in Missouri has increased nearly six times. Also, the plant-food content of this fertilizer has continued upward. To the best knowledge of those in the fertilizer industry, the nitrogen, phosphorus, and potash content of fertilizer used in the U. S. has climbed to at least 26 per cent. However, the last 10 years, the plant-food content of fertilizer used in Missouri has risen from 21 per cent to 32.5 per cent. And, the Corn Belt States are using an increasingly greater proportion of the total fertilizer used in the country. Missouri farmers used 15.4 per cent more fertilizer in 1954 than they had during the previous year.

Increased Soil Testing

Evidence that Missouri farmers are becoming more conscious of the value of proper soil treatment is the increase in the number of soil samples tested in the county laboratories of the State last year. With soil-testing laboratories now in 98 of Missouri's 114 counties, farmers during 1954 had more than 116,000 soil samples tested. This is the highest number ever tested in any one year and it represents an increase of more than 63 per cent over 1953.

The number of farmers having soil tests made increased even more for 1954. Since 1948, the number of farmers using county testing facilities has increased more than five times and, during 1954, 61,000 Missouri farmers had soil samples tested, an increase of 150 per cent over 1953.

Results of such fertilizer usage are evident. The large wheat crops during the past two years are the results of good fertilization practices and good land use. The 1954 State wheat crop averaged 31 bushels an acre and this year's harvest would indicate that the Missouri acre yield of this crop is even greater. Reports are already coming in from all parts of the State of more than 100 bu. per acre corn yields.

Most Missouri farmers have seen the value of fertilizer use clearly demonstrated and the total tonnage used in the State undoubtedly will keep rising steadily. More and more farmers are taking advantage of the facilities now available in county-soil-testing laboratories throughout the State.

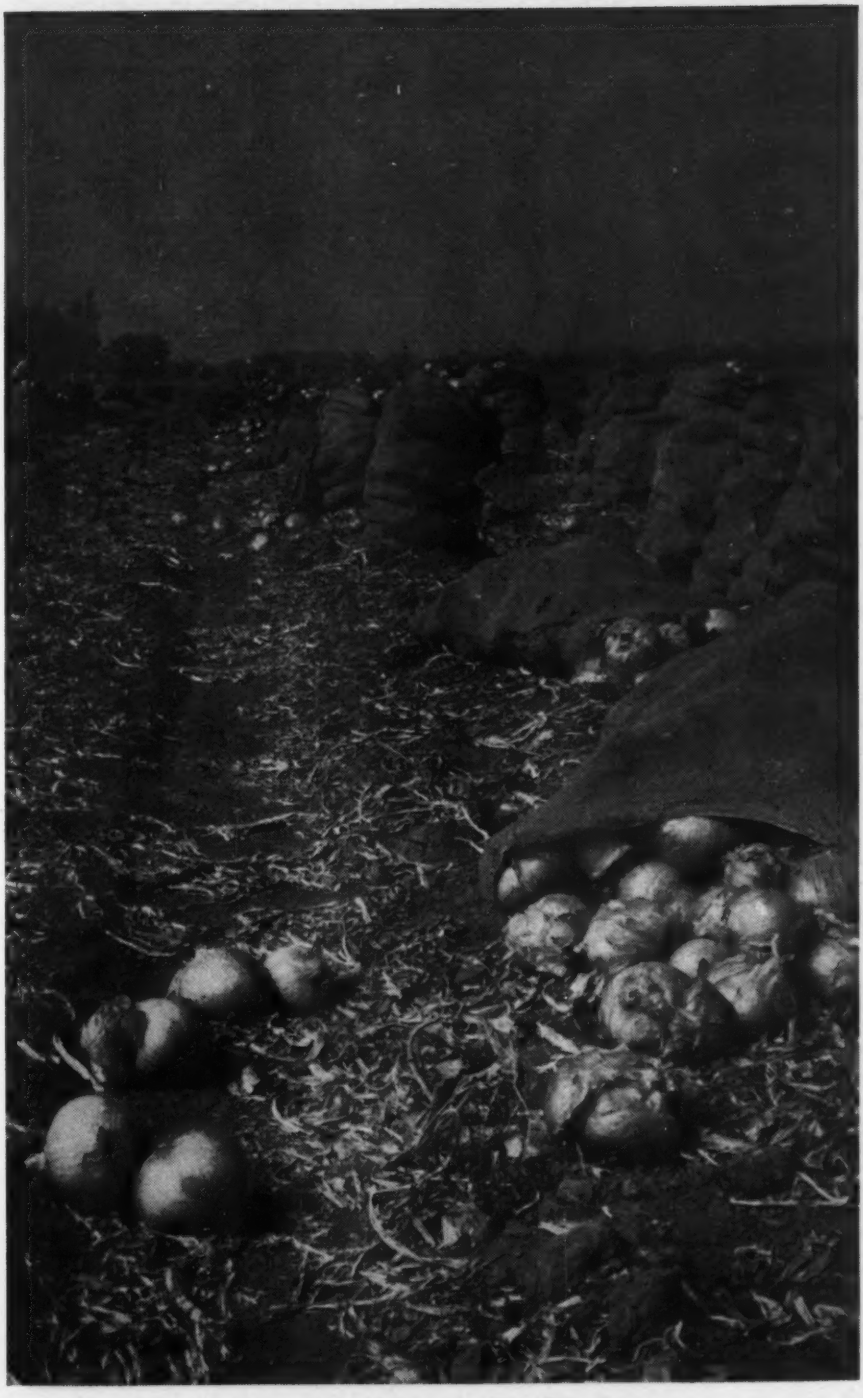
Representative Samples Important

Any farmer in the State can use this service to best advantage by working closely with his county agent. The soil samples taken to him should represent the surface seven inches of each different kind of soil in each field to be tested. If soil samples are not properly taken, tests will not be reliable. The kind of soil counts and if heavy soil treatments have been applied or heavy crops harvested from the field in recent years, the county agent should be told about them. He will have instructions on how to properly take soil samples and the added information that will be needed so that the best suggestions on the soil treatments for most profitable returns can be given.

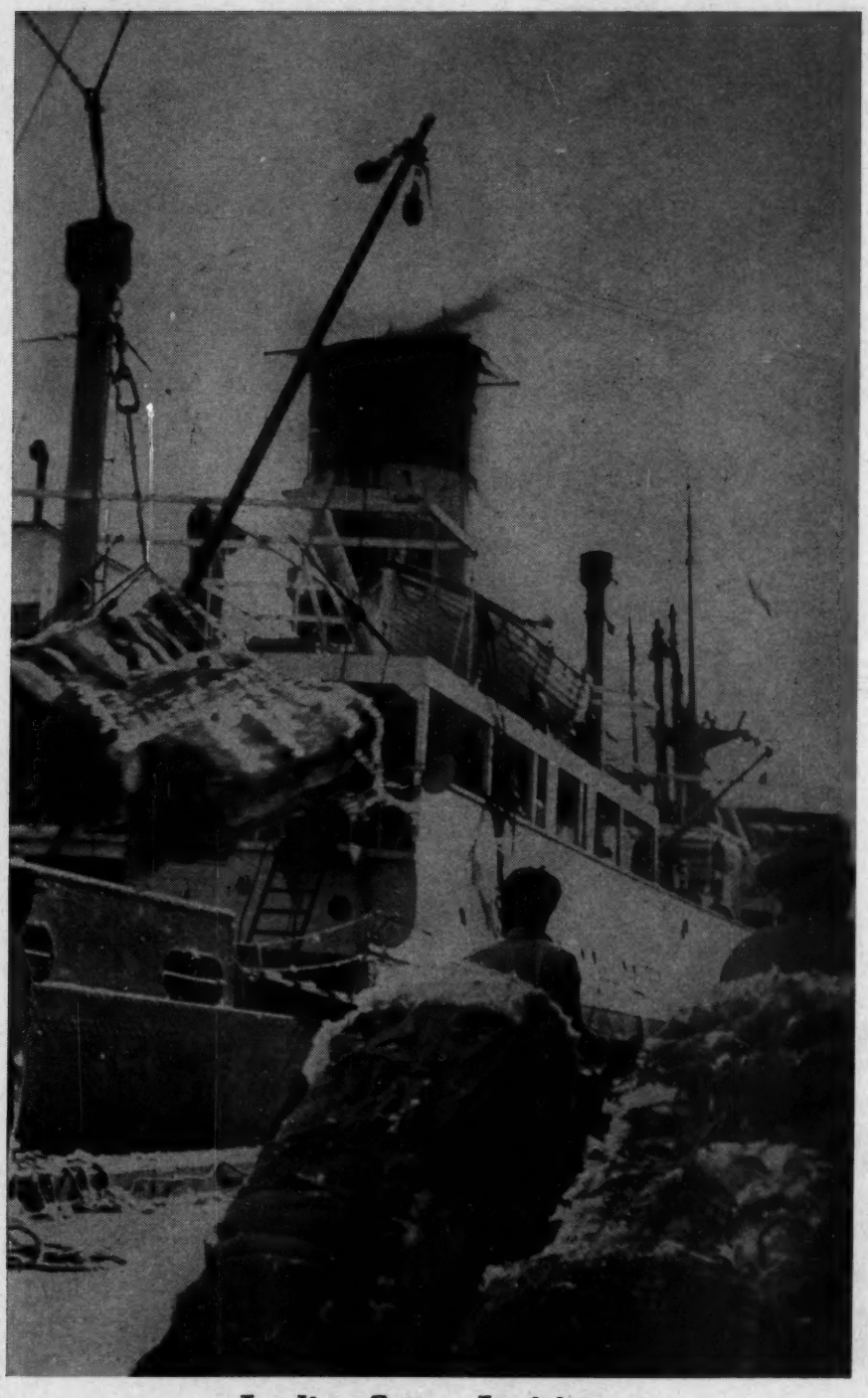
PICTORIAL

Harvesting Cabbage, Connecticut

Grading Apples, New York



Bagging Onions, California



Loading Cotton, Louisiana

The Editors Talk

He Did It

In the August-September issue of this magazine we ran the report of Lamar Ratliff, 15-year-old 4-H corn club boy from Baldwyn, Mississippi, on his 5-year endeavor to beat the world record corn yield. This year he did it, the first grower to ever produce more than 300 bushels of corn per acre.

The remarkable achievement of this young man was not a "stroke of luck." Determination and study behind his previous yields of 179, 187, 214.1, 165, and 218.5 bushels per acre qualified him for the recognition of every cultural practice and detail of management involved in successful corn growing. He learned disappointment and how to overcome it. He had followed the suggestions of his advisers as to fertilization, seed, and plant population. His 304.38 bushels per acre this year was the pay-off.

Our congratulations to Lamar Ratliff! The record, as records often are, may be soon exceeded, but the inspiration engendered by this youthful grower will not soon be forgotten. It will serve to remind us of the dependence we can place on our young Americans to keep this country in the vanguard of progress for civilization.

Our Cover Picture

The olive tree has been with us for centuries. It has occupied a place in religious history since Biblical times, and the Spanish missions in California each had plantings of these trees, some of which are still flourishing. The olive branch has long been a symbol of peace. The tree itself has gray-green, narrow leaves, and is considered an evergreen. It presents a beautiful, soft gray mass of foliage, contrasting with the brighter green foliage of other trees.

The fruit finally turns from its unripe green stage to a shiny black when ripe. Its bitterness is intense at all stages, as many an unsuspecting victim can testify. However, by various methods of processing, the olive has found favor as a relish, as a sandwich spread, and as an ingredient of cookery. The oily nature of the fruit has been the basis for the olive oil industry. This oil is highly prized for the flavor it imparts to salads and to southern European cooking.

California accounts for practically all of the commercial production of olives in the United States. In 1954 this State produced 50,000 tons of olives from 28,163 acres of bearing trees. These olive groves are concentrated in the warmer interior valleys and in southern California. The tonnage for canning has greatly exceeded the tonnage crushed for oil during the past few years. The estimated 1954 return to growers for crushing olives was $64.00 per ton, while olives suitable for canning returned the grower $226.00 per ton.

The usual fertilizer practice for olives is application of a nitrogen fertilizer, such as sulfate of ammonia. Leaf sampling and leaf analysis throughout the olive-growing areas in the past decade revealed that a potash deficiency existed in the

important Oroville area of Butte County. Massive applications of potash applied to these groves improved the trees greatly, increasing both yield and fruit size.

The olive leaves pictured on the cover of this issue represent a normal leaf at the left, with leaves showing various stages of potassium-deficiency symptoms. The normal olive leaf contained 0.73% K and K-deficient leaves 0.28% K.

The fruit on the left was from trees treated with 35 pounds of muriate of potash per tree, while the small olives at the right are from adjacent check trees which received no potash fertilizer.

Again We Give Thanks

In thumbing through some old clippings, we recently came across the following from the November 23, 1935, issue of the Wisconsin Agriculturist and Farmer. We quote, because thought and wording for Thanksgiving are as appropriate now as 20 years ago.

"While The Earth Remaineth, Seedtime And Harvest . . . Shall Not Cease—Gen. 8:2. The promise in the first Book of the Book of Books must surely have been the creed by which our pioneers lived. Those indomitable men and women who turned their faces to the West and established their humble homes with prayers in their souls and songs on their lips, and dreams in their hearts for fertile farms and happy security for themselves and those to come after them.

"Surely, after one year—two years—three years—of drouth and grasshoppers and hail and winds to destroy and wipe out in a week the labors of a season; when no harvest followed that year's seedtime, surely they must have said over and over to themselves the promise that while the earth remaineth, harvest shall not cease. Their eyes beheld the earth, their hands encompassed the soil, and their hearts laid firm hold onto faith that better times should come to them and their dreams for posterity should be realized.

"At this Thanksgiving time, if we forget all else but the soil upon which we live and its faithfulness to its task, we can feel that these dreams have been realized. Exclusive of hindrances and obstacles which may exist in the lives of many of us to prevent our living life to its fullest and happiest, the soil with its seedtime and harvest is ever-abiding. In proportion as we are good to the soil, it is good to us.

"If the harsh glare of drouth lays its arresting hand on the bosom of the earth to retard its harvest, when the rains come, as they always do eventually, the soil forgives freely and blossoms forth in returned sustenance from the plants and seed we rush to plant in her warm breast. If too much rain soaks the soil so that no good plant life can flourish, a week of dry weather sends us forth with plows and hoes to the seedtime and the soil furnishes the harvest. Drouth, too much moisture, meagre finances for large crop plans, weakness of our physical selves to take advantage of the earth's large opportunity may cause harvests to be small, but the soil always fulfills its promise of 'harvest to follow seedtime.'

"The folk who live so near the soil and depend so much on it are rich in blessing because they have a firm rock upon which to pin their faith. As tillers of the soil, at the time of the gathering of earth's bounty into the storehouse we stop to bow our heads in true thanksgiving that such a rich heritage is ours. The farm life, now, as perhaps no other time, becomes the full and satisfying life.

"The work of our hands, the plans of our minds, the hopes of our hearts, all centered in the soil have borne fruit which we have stored for security."

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	28.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949.....	28.6	45.9	128.0	214.0	124.0	188.0	16.50	43.40	....
1950.....	40.1	51.7	91.7	173.0	153.0	200.0	16.70	86.50	....
1951.....	37.9	51.1	163.0	304.0	166.0	211.0	19.50	69.30	....
1952.....	34.6	49.9	198.0	338.0	153.0	209.0	19.95	69.60	....
1953.....	32.3	52.2	79.7	251.0	148.0	204.0	17.45	52.60	....
1954									
October.....	34.67	53.6	93.2	212.0	145.0	208.0	17.55	60.20	....
November...	33.17	52.0	109.0	216.0	137.0	212.0	18.15	59.40	....
December....	32.67	50.0	105.0	254.0	139.0	212.0	18.55	59.60	....
1955									
January.....	32.51	42.4	113.0	283.0	140.0	214.0	18.75	56.80	....
February....	31.69	36.8	117.0	297.0	140.0	213.0	18.55	55.20	....
March.....	31.87	....	118.0	310.0	136.0	212.0	18.25	53.40	....
April.....	31.93	....	217.0	315.0	136.0	209.0	17.65	53.40	....
May.....	31.51	46.0	223.0	315.0	140.0	213.0	17.45	53.10	....
June.....	31.43	39.5	121.0	392.0	140.0	206.0	16.35	52.00	....
July.....	32.11	38.0	88.0	279.0	140.0	197.0	15.25	54.00	....
August.....	32.74	50.6	75.2	179.0	130.0	190.0	15.25	50.10	....
September...	33.77	51.5	71.3	142.0	124.0	192.0	15.55	43.70	....
Index Numbers (Aug. 1909–July 1914 = 100)									
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	128
1931.....	46	82	66	83	50	44	73	40	107
1932.....	52	105	55	62	50	43	52	46	100
1933.....	82	130	118	79	81	84	68	57	90
1934.....	100	213	64	91	127	96	111	146	94
1935.....	90	184	85	80	102	94	63	135	116
1936.....	100	236	164	106	163	116	94	148	108
1937.....	68	204	76	89	81	109	74	87	114
1938.....	69	196	80	79	76	64	57	97	96
1939.....	73	154	100	84	88	78	67	94	98
1940.....	80	160	78	97	96	77	64	96	122
1941.....	137	264	116	105	117	107	82	211	138
1942.....	153	369	168	134	143	124	91	202	178
1943.....	160	405	188	235	174	154	125	231	270
1944.....	167	420	214	216	170	160	139	234	236
1945.....	181	366	205	232	198	170	127	227	240
1946.....	263	382	178	248	212	209	141	319	217
1947.....	257	380	232	248	336	259	148	381	262
1948.....	245	482	222	253	201	226	155	298	253
1949.....	231	459	184	244	193	213	139	192	232
1950.....	323	517	132	197	238	226	141	384	211
1951.....	306	512	233	346	259	239	164	307	269
1952.....	279	499	284	385	238	236	168	309	274
1953.....	260	522	114	286	231	231	147	233	240
1954									
October.....	280	536	134	241	226	235	148	267	191
November...	268	520	156	246	213	240	153	263	237
December....	263	500	151	289	217	240	156	264	216
1955									
January.....	262	424	162	322	218	242	158	252	263
February....	256	368	168	338	218	241	156	245	258
March.....	257	...	169	353	212	240	154	237	262
April.....	258	...	311	359	212	236	149	237	270
May.....	154	460	320	359	218	241	147	235	308
June.....	253	395	174	435	218	233	138	231	230
July.....	259	380	126	318	218	223	128	239	223
August.....	264	506	108	204	202	215	128	222	211
September...	272	515	102	162	193	217	131	194	230

Wholesale Prices of Phosphates and Potash * *

	Superphosphate, Baltimore, per unit	Florida land, pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports [1]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports [1]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports [1]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports [1]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950	.763	3.83	5.47	.371	.716	14.33	.195
1951	.813	3.98	5.47	.401	.780	15.25	.200
1952	.849	3.98	5.47	.401	.793	15.25	.200
1953	.878	....	....	....	.793	15.25	.200
1954							
October	.895	....	....	.388	.765	14.75	.184
November	.895	....	....	.388	.765	14.75	.184
December	.895	....	....	.405	.825	16.00	.193
1955							
January	.895	....	....	.405	.825	16.00	.193
February	.895	....	....	.405	.825	16.00	.193
March	.895	....	....	.405	.825	16.00	.193
April	.895	....	....	.405	.825	16.00	.193
May	.895	....	....	.405	.825	16.00	.193
June	.895	....	....	.360	.720	13.45	.175
July	.895	....	....	.390	.735	14.00	.193
August	.895	....	....	.390	.735	14.00	.193
September	.895	....	....	.390	.735	14.00	.193
			Index Numbers (1910-14 = 100)				
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950	142	106	112	68	75	59	83
1951	152	110	112	72	82	63	83
1952	158	110	112	72	83	63	83
1953	164	...	...	73	83	63	83
1954							
October	167	...	...	70	80	61	81
November	167	...	...	70	80	61	81
December	167	...	...	72	87	66	83
1955							
January	167	...	...	72	87	66	83
February	167	...	...	72	87	66	83
March	167	...	...	72	87	66	83
April	167	...	...	72	87	66	83
May	167	...	...	72	87	66	83
June	167	...	...	66	76	56	80
July	167	...	...	70	77	58	82
August	167	...	...	70	77	58	82
September	167	...	...	70	77	58	82

Wholesale Prices of Ammoniates * *

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish, scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17 % ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.60	1.38	3.69	3.76	3.15	3.53
1939	1.60	1.35	4.02	4.41	3.87	3.90
1940	1.60	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950	3.00	1.95	11.01	11.70	10.21	9.36
1951	3.16	1.97	13.20	10.92	10.18	10.09
1952	3.34	2.09	13.95	11.27	9.72	9.16
1953	3.26	2.27	11.04	11.19	7.39	7.09
1954						
October	3.01	2.18	11.55	11.26	9.64	9.94
November	2.98	2.18	11.85	11.78	8.80	9.23
December	2.98	2.18	11.98	12.41	8.50	8.35
1955						
January	2.98	2.18	12.00	12.35	8.32	8.32
February	2.98	2.18	11.16	12.23	8.50	8.50
March	2.98	2.18	10.47	12.45	7.82	7.82
April	2.98	2.18	9.90	12.41	6.68	6.23
May	2.98	2.16	9.97	11.92	6.19	6.25
June	2.98	2.02	9.91	11.55	6.23	5.92
July	2.98	2.02	10.01	9.43	6.68	7.14
August	2.98	2.07	9.88	11.12	7.04	6.86
September	2.98	2.05	9.29	11.60	6.75	6.53
	Index Numbers (1910-14 = 100)					
1929	96	72	161	142	137	162
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950	112	68	315	331	303	266
1951	118	69	377	310	302	287
1952	125	74	399	319	288	260
1953	122	80	315	317	219	201
1954						
October	112	76	330	319	286	282
November	111	76	339	334	261	262
December	111	76	342	352	252	237
1955						
January	111	76	343	350	247	236
February	111	76	319	346	252	241
March	111	76	299	353	232	222
April	111	76	283	352	198	177
May	111	76	285	338	184	178
June	111	71	283	327	185	168
July	111	71	286	267	198	203
August	111	73	282	315	200	195
September	111	72	265	329	200	186

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and All Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1929.....	148	150	139	114	79	146	114	97
1930.....	125	140	126	105	72	131	101	99
1931.....	87	119	107	83	62	83	90	99
1932.....	65	102	95	71	46	48	85	99
1933.....	70	104	96	70	45	71	81	95
1934.....	90	118	109	72	47	90	91	72
1935.....	109	123	117	70	45	97	92	63
1936.....	114	123	118	73	47	107	89	69
1937.....	122	130	126	81	50	129	95	75
1938.....	97	122	115	78	52	101	92	77
1939.....	95	121	112	79	51	119	89	77
1940.....	100	122	115	80	52	114	96	77
1941.....	124	130	127	86	56	130	120	77
1942.....	159	149	144	93	57	161	112	77
1943.....	193	165	151	94	57	160	117	77
1944.....	197	174	152	96	57	174	120	76
1945.....	207	180	154	97	57	175	121	76
1946.....	236	197	177	107	62	240	125	75
1947.....	276	231	222	130	74	362	139	72
1948.....	287	250	241	134	89	314	143	70
1949.....	250	240	226	137	99	319	144	70
1950.....	258	246	232	132	89	314	142	72
1951.....	302	271	258	139	93	331	152	76
1952.....	288	273	251	144	98	333	158	76
1953.....	258	262	247	139	100	269	164	77
1954								
October...	242	262	248	141	94	308	167	74
November.	244	262	248	140	93	301	167	74
December..	239	261	245	140	93	300	167	77
1955								
January...	244	264	248	140	93	297	167	77
February..	245	264	248	139	93	291	167	77
March.....	244	265	248	137	93	275	167	77
April.....	247	265	248	135	93	252	167	77
May.....	244	263	248	134	93	243	167	77
June.....	243	263	248	131	90	242	167	70
July.....	237	262	248	132	90	240	167	74
August....	233	260	248	133	91	252	167	74
September.	235	259	250	132	91	244	167	74

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] Potash salts quoted F.O.B. mines; manure salts since June 1941; other carriers since June 1947. Beginning June 1954, muriate of potash quoted on both mine and port basis.

*** * Where range of prices for fertilizer material is quoted, average figure is used. The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Nutrient Requirements of Arizona Cotton, a Report of Tissue Analyses from Cotton Fertilizer Experiments," Agr. Exp. Sta., Univ. of Ariz., Tucson, Ariz., Rpt. No. 117, March 1955, J. L. Abbott, W. T. McGeorge, and E. L. Breazeale.

"Tonnage of Commercial Fertilizer Reported by Manufacturers as Sold in Kansas in the Spring of 1955, by Counties, Kansas State Board of Agriculture, Control Division, Topeka, Kansas, January 1, 1955, to June 30, 1955," State Dept. of Agr., Topeka, Kans.

"Commercial Fertilizers, 1954, and Official Inspections 233," Agr. Exp. Sta., Univ. of Maine, Orono, Maine, Oct. 1954.

"Official Report of the Maryland Inspection and Regulatory Service, Feed, Fertilizer and Lime Issue," Inspection & Regulatory Service, College Park, Md., Issue No. 235, Aug. 1955.

"A Flame Photometric Method for Potash in Fertilizers, Ion Exchange Separation of Interfering Anions," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo., Res. Bul. 571, Nov. 1954, C. W. Gehrke, H. E. Affsprung, and E. L. Wood.

"Missouri Fertilizer Tonnage Report, January 1 to June 30, 1955," Agr. Exp. Sta., Univ. of Mo., Columbia, Mo.

"When to Apply Anhydrous Ammonia to Cotton," Agr. Exp. Sta., N. Mex. A. & M. College, State College, N. Mex., Press Bul. 1135, March 1955, M. R. Pack.

"Comparison of Four Nitrogen Fertilizers on Cotton," Agr. Exp. Sta., N. Mex. A. & M. College, State College, N. Mex., Press Bul. 1137, March 1955, H. E. Dregne.

"Fertilizer Demonstrations, Spring Planted Crops, 1954," Agr. Ext. Serv., Okla. A. & M. College, Stillwater, Okla. Cir. 629, G. Hanes, G. Stroup, and W. Chaffin.

"Distribution of Fertilizer in Oklahoma Counties by Grades and Material for the Period July 1, 1954 to July 1, 1955," State Dept. of Agr., Okla. City, Okla., Ann. Rpt., 1955.

"Grain Sorghum Fertilizer Tests at the Blackland Experiment Station, 1952-54," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1803, July 1955, E. D. Cook and W. R. Parmer.

"Effect of Fertilizers on Yield and Composition of Pasture Forage Near College Station," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1811, F. L. Fisher, A. G. Caldwell, and J. F. Fudge.

"Pasture Fertilization in Northwestern Washington," Agr. Exp. Stas., State College of Wash., Pullman, Wash., Bul. 558, March 1955, H. M. Austenson, W. E. Chapin, and A. G. Law.

"Fertilizers for Profitable Production," Agr. Ext. Serv., Univ. of W. Va., Morgantown, W. Va., Ext. Cir. 371, Feb. 1955.

Soils

"Soil and Water Losses in Southwest Arkansas as Influenced by Rainfall Characteristics and Soil Management Practices," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 550, April 1955, R. P. Bartholomew, D. A. Hinkle, and K. Engler.

"Hints on Dry Land Gardening," Dept. of Agr., Ottawa, Ont., Can., Pub. 619, Rev. May 1955, C. Walkof.

"Growing Tomatoes on the Sandy Soils of Peninsular Florida," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 563, June 1955, E. L. Spencer, D. G. A. Kelbert, E. G. Kelsheimer, and D. S. Burgis.

"The Establishment of Sweet Clover in Dry Land Areas," Agr. Exp. Sta., Univ. of Idaho, Moscow, Idaho, Bul. 227, March 1955, F. H. Siddoway and H. C. McKay.

"Ridge Planting Saves Soil, Water," Agr. Exp. Sta., Iowa State College, Ames, Iowa, FS-607, June 1955, W. F. Buchele, E. V. Collins, and W. G. Lovely.

"Soil Testing—Science in Action on the Farm," Agr. Ext. Serv., Miss. State College, State College, Miss., Pub. 299, May 1955, E. Gholston and I. E. Miles.

"Supplemental Irrigation for Summer Permanent Pastures in the Hill Sections of Mississippi," Agr. Exp. Sta., Miss. State College, State College, Miss., Cir. 196, June 1955, H. W. Bennett, N. Merwine, and E. A. Kimbrough.

"Irrigated Pastures for Nebraska," Agr. Ext. Serv., Univ. of Nebr., Lincoln, Nebr., EC 55-108, March 1955, D. F. Burzlaff.

"Liming New Hampshire Soils," Agr. Ext. Serv., Univ. of N. H., Durham, N. H., Ext. Fldr. 30, April 1955, R. L. Donahue.

"Our New Jersey Land," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Bul. 775, Jan. 1955, G. A. Quakenbush.

"Soil Management of Bright Tobacco in Lower Piedmont," Agr. Exp. Sta., N. C. State College, Raleigh, N. C., Bul. 392, Jan. 1954, T. L. Copley, L. A. Forrest, and W. G. Waltz.

"Conservation in Irrigation," Agr. Ext. Serv., Oreg. State College, Corvallis, Oreg., Ext. Cir. 580, Dec. 1954, M. H. Shearer.

"More Mountain Meadow Hay with Fertilizer," Agr. Exp. Sta., Oreg. State College, Corvallis, Oreg., Sta. Bul. 550, June 1955, Clee S. Cooper.

"Wind Erosion Control in the Columbia Basin," Agr. Exp. Stas., State College of Wash., Pullman, Wash., Stas. Cir. 268, May 1955, S. J. Mech.

"Soil Survey, Sulphur Spring Valley Area, Arizona," USDA, Wash., D. C., Series 1940, No. 14.

"Soil Survey, Cass County, Indiana," USDA, Wash., D. C., Series 1939, No. 24.

"Soil Survey, Newton County, Indiana," USDA, Wash., D. C., Series 1941, No. 14.

"Soil Survey, McLeod County, Minnesota," USDA, Wash., D. C., Series 1940, No. 17.

"Soil Survey, Avery County, North Carolina," USDA, Wash., D. C., Series 1946, No. 1.

Crops

"Progress and Potentials in Plant Introduction for the South," Ala. Polytechnic Institute, Auburn, Ala., Southern Coop. Series Bul. 27, April 1955, E. James.

"Sorghum Yield Experiments, 1950 to 1954," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Rpt. Series 46, Feb. 1955, R. L. Thurman and R. D. Staten.

"Alfalfa Production Experiments 1950-1954," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Rpt. Series 48, March 1955, P. C. Sandal and J. F. Jacks.

"Rice Varieties and Their Yields in Arkansas, 1948-1954," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Rpt. Series 49, May 1955, T. H. Johnston and E. M. Cralley.

"Thirty-Fifth Annual Report for the Period Ending December 31, 1954," State Dept. of Calif., Sacramento, Calif., Vol. XLIII, No. 4.

"Hybrid Vegetables for Short-Season Gardens," Dept. of Agr., Ottawa, Ont., Can., Pub. 947, May 1955, C. Walkof and V. W. Nuttall.

"Reed Canary Grass," Dept. of Agr., Ottawa, Ont., Can., Pub. 805, Rev. May 1955, W. J. White, R. M. MacVicar, and F. S. Nowosad.

"Dominion Experimental Station, Scott, Saskatchewan, Progress Report 1948-1953," Exp. Farms Serv., Dept. of Agr. Ottawa, Ont., Can., June 1955.

"Blight Resistant Chestnuts," Agr. Exp. Sta., New Haven, Conn., Cir. 192, March 1955, H. Nienstaedt and A. H. Graves.

"Growing Strawberries in Florida," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 160, June 1955, A. N. Brooks.

"Growing Camellias in Florida," Agr. Ext. Serv., Univ. of Fla., Gainesville, Fla., Bul. 161, June 1955, E. W. McElwee.

"Control of Blackheart of Celery," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Cir. S-83, June 1955, C. M. Geraldson.

"Azalea Culture," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Press Bul. 659, June 1955, R. J. Wilmot and R. D. Dickey.

"Producing Birdsfoot Trefoil Seed," Agr. Exp. Sta., Iowa State College, Ames, Iowa, FS-608, June 1955, H. E. Thompson and D. S. Metcalfe.

"Research Progress at the Illinois Agricultural Experiment Station, Report for 1952-1954," Agr. Exp. Sta., Univ. of Ill., Urbana, Ill., March 1955.

"Keeping Southern Illinois Pastures Productive," Agr. Ext. Serv., Univ. of Ill., Urbana, Ill., Cir. 740, April 1955, H. A. Cate.

"Growing Strawberries in Kansas," Agr. Exp. Sta., Kans. State College, Manhattan, Kans., Cir. 317, March 1955, R. W. Campbell and W. G. Amstein.

"Louisiana Rice," Agr. Ext. Serv., La. State Univ., Baton Rouge, La., Ext. Pub. 1182, Rev. March 1955, R. A. Wasson and R. K. Walker.

"Advancing Agricultural Horizons Through Research, Sixty-Seventh Annual Report, 1953-54," Agr. Exp. Sta., Univ. of Md., College Park, Md., Bul. A-81, Feb. 1955.

"1954 Extension Work, Fortieth Annual Report," Agr. Ext. Serv., Univ. of Md., College Park, Md.

"Golden Beauty Sweet Corn," Agr. Exp. Sta., Univ. of Mass., Amherst, Mass., Bul. 479, Feb. 1955, W. H. Lachman.

"Soybeans for Oil," Agr. Ext. Serv., Miss. State College, State College, Miss., Pub. 296, April 1955, W. R. Thompson.

"The Influence of Deep Tillage on Cotton Production in the Yazoo-Mississippi Delta," Agr. Exp. Sta., Miss. State College, State College, Miss., Inf. Sh. 507, Feb. 1955, P. Grissom, E. B. Williamson, O. B. Wooten, F. E. Fulgham, and W. A. Raney.

"Nebraska Varietal Tests of Fall-Sown Small Grains, 1955," Agr. Exp. Sta., Univ. of Nebr., Lincoln, Nebr., Outstate Testing Cir. 44, Aug. 1955, A. F. Dreier, J. W. Schmidt, and P. L. Ehlers.

"Growing Strawberries in New Hampshire," Agr. Ext. Serv., Univ. of N. H., Durham, N. H., Ext. Bul. 125, May 1955, L. P. Latimer.

"Lawn Care," Agr. Ext. Serv., Rutgers Univ., New Brunswick, N. J., Ext. Bul. 286, March 1955, R. E. Engel.

"Growing Christmas Trees in New Jersey," Agr. Ext. Serv., Rutgers Univ., New Brunswick, N. J., Ext. Bul. 289, March 1955, A. N. Lentz.

"The Evaluation of Forage Crops Varieties and Strains for Use and Adaptation in the Northeast," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., N. E. Reg. Pub. 19, Bul. 777, July 1954.

"Home Vegetable Gardening," Agr. Ext. Serv., N. Mex. A. & M. College, State College, N. Mex., Cir. 254, Feb. 1955, W. J. Wiltbank.

"Lawns for Albuquerque and Northern New Mexico," Agr. Ext. Serv. N. Mex. A. & M. College, State College, N. Mex., Cir. 258, March 1955.

"1517 BR, a Blight-Resistant Strain of Acala Cotton," Agr. Exp. Sta., N. Mex. A. & M. College, State College, N. Mex., Press Bul. 1132, Jan. 1955, L. M. Blank and R. E. Hunter.

"Seventy-Third Annual Report, 1954, Cornell University," Agr. Exp. Sta., Geneva, N. Y.

"Oats, Which Variety Should We Grow?" Agr. Exp. Sta., N. Dak. Agr. College, Fargo, N. Dak., Bul. 397, April 1955, T. E. Stoa and C. M. Swallers.

"The Home Flower Garden," Agr. Ext. Serv., Ohio State Univ., Columbus, Ohio, SB 13, March 1955, V. H. Ries.

"Farm Pond Management," Agr. Ext. Serv., Ohio State Univ., Columbus, Ohio, Bul. 336, June 1955, R. K. Davis.

"Castorbean Variety Trials and Production in Texas, 1954," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1802, July 1955, D. D. Poole.

"Small Grains, Grasses and Legumes for Winter Forage Production in Matagorda County, 1954-55," Agr. Exp. Sta., Tex. A. & M. College, College Station, Tex., Prog. Rpt. 1810, August 1955, M. E. Riewe and D. C. Pfannstiel.

"Agronomic Investigations in Sanpete, Sevier, and Wayne Counties, 1954, A Progress Report of Research on Methods for Increasing Crop Production," Agr. Exp. Sta., Utah State Agr. College, Logan, Utah, Mimeo. Series 417, March 1955.

"Minor Element Content of Forage Plants from the Coastal Plain Region of Virginia," Agr. Exp. Sta., Va. Polytechnic Institute, Blacksburg, Va., Tech. Bul. 123, April 1955, N. O. Price, W. N. Linkous, and R. W. Engel.

"Recommendations for Cranberry Production in Washington," Agr. Ext. Serv., State College of Wash., Pullman, Wash., Ext. Cir. 144, Rev. March 1955, D. H. Brannon, M. R. Harris, R. E. Tidrick, C. C. Doughty, and H. S. Telford.

"Sixty-Fourth Annual Report," Agr. Exp. Stas., State College of Wash., Pullman, Wash., Bul. 559, Dec. 1954.

"Pasture Mixtures for Upland Soils in Northwest Washington," Agr. Exp. Stas., State College of Wash., Pullman, Wash., Stas. Cir. 260, Jan. 1955, W. E. Chapin, A. G. Law, and A. L. Hafenrichter.

"Roses in Your Garden," Agr. Ext. Serv., State College of Wash., Pullman, Wash., Ext. Mimeo. 1667.

"What's New in Farm Science," Agr. Exp. Sta., Univ. of Wis., Madison, Wis., Bul. 512, Jan. 1955, R. D. Powers and R. J. Muckenhirn.

"Success With Peonies," Agr. Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 494, Feb. 1955.

"Shelterbelts Guard the Soil Against Blowing and Drifting," Agr. Ext. Serv., Univ. of Wis., Madison, Wis., Cir. 495, April 1955, F. B. Trenk.

"Safflower in Wyoming," Agr. Exp. Sta., Univ. of Wyo., Laramie, Wyo., Bul. 332, Feb. 1955, W. A. Riedl.

"Effect of Pasture Fertility on Milk Production," Agr. Exp. Sta., Univ. of Wyo., Laramie, Wyo., Mimeo. Cir. 55, March 1955, D. C. Brown, R. L. Lang, T. J. Dunnewald, and R. J. Hyer.

Economics

"Adjusting to Rice Controls," Agr. Exp. Sta., Univ. of Calif., Davis, Calif., Lflt. 47, March 1955, G. R. Sitton, A. D. Reed, and L. L. Davis.

"Handbook of Agricultural Statistics, August 1955," Dept. of Agr., Ottawa, Ont., Can., Ref. Paper No. 25, Part 3.

"Peanut Price and Income Support Programs," Agr. Exp. Sta., Univ. of Ga., Athens, Ga., Mimeo Series N. S. 9, June 1955, N. M. Penny, J. C. Purcell, and J. C. Elrod.

"Costs and Returns for Soil-Conserving Systems of Farming on Ida-Monona Soils in Iowa," Agr. Exp. Sta., Iowa State College, Ames, Iowa, Res. Bul. 429, June 1955, R. V. Baumann, E. O. Heady, and A. R. Aandahl.

"Economic Factors That Affect Wheat in Kansas," Agr. Exp. Sta., Kans. State College, Manhattan, Kans., Bul. 369, Jan. 1955, L. M. Hoover and J. H. McCoy.

"Economic Trends in the Sweet Potato Industry," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., DAE Cir. 168, Oct. 1954, A. C. Harper and M. D. Woodin.

"Costs and Returns on Family-Type Sugar Cane Farms, 1953 and Three-Year Average, 1950-51-52," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., DAE Cir. 171, Dec. 1954, J. R. Campbell and J. N. Efferson.

"Costs and Returns on Large Sugar Cane Farms, 1953 Crop Year," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., DAE Cir. 172, Feb. 1955, J. R. Campbell and J. N. Efferson.

"Cooperative Farm Business Corporations in Louisiana, 1954," Agr. Exp. Sta., La. State Univ., Baton Rouge, La., DAE Cir. 175, March 1955, B. M. Gile.

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"Individual Factors and Annual Averages from Farm Cost Accounts, 45 Farms, 1953," Agr. Exp. Sta., Cornell Univ., Ithaca, N. Y., AE 978, May 1955.

"Trends in Farm Production," Agr. Exp. Sta., Pa. State Univ., State College, Pa., Bul. 594, March 1955, J. K. Pasto and K. Chen.

"Production Practices and Costs for Improved Pastures in South Carolina," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Bul. 419, July 1954, D. E. Crawford.

"Soybean Production in Virginia," Agron. Dept., Va. Polytechnic Institute, Blacksburg, Va., Cir. 656, May 1955.

"Sweetpotato Prices, Monthly and Season Average Prices Received by Farmers, by States, and United States," USDA, Wash., D. C., Stat. Bul. 163, June 1955.

"Cotton and Cottonseed, Acreage, Yield, Production, Disposition, Price, and Value by States, 1866-1952," USDA, Wash., D. C., Stat. Bul. 164, June 1955.

"Commercial Ornamental Horticulture, Size of Establishment and Crop Specialization of Growers," USDA, Wash., D. C., Mktg. Res. Rpt. No. 96, June 1955.

"Commercial Floriculture, Size of Establishment and Crop Specialization of Growers," USDA, Wash., D. C., Mktg. Res. Rpt. No. 97, June 1955.

"Agricultural Statistics for 1954," USDA, Wash., D. C.

"Losses in Agriculture, a Preliminary Appraisal for Review," USDA, Wash., D. C., June 1954.

Warns Against Reducing Fertilizer Applications

PRODUCING low yields will cut profits, an Extension Agronomist at Ohio State University warns farmers who want to "save money" on fertilizer. E. P. Reed says, "As you increase yields, the unit cost of production decreases whether the units are bushels, pounds, or tons. This is true until you reach the point of diminishing returns. We haven't reached that point yet."

The Agronomist sees no reason at present to apply less than recommended amounts of fertilizer. When farmers keep yields up, they maintain soil productivity as well as reduce costs per unit. "Even when prices are low, we should apply recommended amounts of fertilizer to maintain yields."

Reed makes the statements in response to farmers' questions about how much fertilizer they "can afford to apply" during periods of a price-cost squeeze.

"You can't afford not to apply correct amounts," he adds.

Topdressing Alfalfa

TOPDRESSING alfalfa fields with fertilizer every year is like money in the bank. It brings a good return right away in the form of better hay yields, according to A. M. Strommen and A. R. Albert, research men at the University of Wisconsin.

And it saves fertilizer costs over a period of years, the research men find. They have topdressed alfalfa-brome fields at the Spooner Branch Experiment Station with 300 pounds of fertilizer each year since 1949. For comparison, they left similar stands unfertilized.

Now they report that topdressed fields have been making more than four tons of mixed hay every year, while unfertilized fields have yielded

less than three tons. Increased yield from treated plots the first year was enough to pay the fertilizer bill for the second year.

The research men report similar returns for succeeding years, and enough nutrients remain in the soil for an added two or three tons of hay with no added cost. In another test with a thin alfalfa stand on some of the poorest soil at the Spooner Station, annual topdressing with 300 pounds of 0-9-27B raised hay yields more than three tons over the six-year period.

The researchers also tried every-other-year topdressing at double the annual rate. Though they got similar results, they feel annual topdressing is most convenient to finance on this "pay as you go" schedule.

High-protein Corn . . .

(*From page* 22)

panies have transferred high-protein traits to standard inbred lines with the objective of improving both yield and plant characteristics over those of Illinois High-protein. They have produced several hybrids with well-established characters which carry amounts of protein intermediate between ordinary hybrids and Illinois High-protein. The plants are larger and stronger than those of Illinois High-protein and give larger yields of grain and forage.

Three commercial strains of high-protein yellow dent hybrid corn with grain having 11 to 15% protein were field tested for their value as silage crops at the Illinois Experiment Station, using U. S. Hybrid 13 as a standard for comparison. The commercial high-protein strains were characterized by larger and stronger plants than those of Illinois High-protein.

High Yields of Protein in Forage

The forage was harvested for silage when it had reached the recommended stage of 25 to 30% dry matter, except in 1953 when it had passed this stage and was somewhat too dry. In each year U. S. 13 gave the highest and Illinois High-protein the lowest yields of both fresh matter and dry matter, while the yields of the other strains were intermediate. The forage of U. S. 13 was lowest in protein content, but because of large yields of forage the amounts of protein produced to the acre were as large or larger than those of any of the high-protein strains. In round figures, from 800 to 1,100 pounds of protein were produced per acre. This is about the quantity of protein contained in a 3-ton crop of alfalfa hay ($6{,}000 \times 15\% = 900$). Detailed yield figures are given in Table I.

The data given in Table I are for corn grown on Fields B and H, both of which were high in productivity. Corn was also grown on Field M, the soil

Fig. 4. Trials showed that the extra protein in a day's feeding of high-protein corn silage as compared with ordinary corn silage was equal to half a pound of soybean meal. Man at left takes sample for chemical analysis from each load of experimental silage.

TABLE II.—COMPOSITION OF LEAF-STALK AND EAR PORTIONS OF CORN FORAGE

Kind of corn	Field	Date of sampling	Dry-matter content		Protein content[a]	
			Leaf-stalk %	Ear %	Leaf-stalk %	Grain %
U. S. Hybrid 13.....	B	9–7–50	18.0	40.0	10.0	11.2
Illinois High-protein.....	B	9–7–50	23.2	35.5	11.4	17.4
High-protein corn C.....	B	9–7–50	19.0	41.0	10.4	10.2
U. S. Hybrid 13.....	M	9–7–50	21.4	37.8	5.5	8.1
High-protein corn D.....	M	9–7–50	23.3	41.0	5.1	7.7

[a] Dry-matter basis.

of which was badly depleted of fertility. Both the leaf-stalk portion and the ears of corn forage from Field M were markedly lower in protein content than the forage from Field B (Table II). The effect of fertilizer treatment on corn forage grown on poor soil is shown in Table III. These figures indicate that high-protein strains of corn must have ample amounts of available nitrogen during the growing period in order to reach the protein percentages of which they are capable.

Studies of the character of the protein in high-protein corn which have been carried out at the Illinois, Iowa, Ohio, and Purdue Experiment Stations have shown that the protein of low-protein corn is more nearly balanced nutritionally than the protein of high-protein corn. Zein, one of the principal proteins of the corn kernel, makes up a larger proportion of the total protein of high-protein corn than of low-protein corn. Zein is deficient in lysine and tryptophane, two of the amino acids essential in nutrition. Feeding trials were therefore carried out to determine whether or not high-protein corn is a satisfactory feed. Trials have been conducted with dairy cattle, beef cattle, sheep, and swine.

Rarely is corn the only component of the livestock ration. Usually corn is fed with other grains and/or protein supplements together with small amounts of roughage (e.g., to fattening steers) or with large amounts of roughage in the case of dairy cows, beef breeding herds, and sheep. Not only

TABLE III.—THE EFFECT OF FERTILIZATION ON THE PROTEIN CONTENT OF CORN FORAGE GROWN ON POOR SOIL

Kind of corn	Field	Date of harvest	Dry-matter content %	Acre yield of forage		Protein	
				Fresh basis tons	Dry basis tons	In dry matter %	Yield per acre lb.
Illinois High-protein...	M[a]	9–22–51	36.0	6.9	2.5	10.0	500
High-protein corn C....	M[a]	9–22–51	33.8	9.9	3.2	6.8	440
High-protein corn D....	M[a]	9–22–51	36.8	5.6	2.1	7.3	300
Illinois High-protein...	M[b]	9–22–51	31.3	9.1	2.8	10.2	580
High-protein corn C....	M[b]	9–11–51	27.7	13.0	3.6	8.2	590
High-protein corn D....	M[b]	9–22–51	36.1	8.9	3.2	8.7	560

[a] Nonfertilized.
[b] Fertilized.

do the proteins of the various feeds supplement each other, furnishing a good assortment of amino acids, but in ruminant digestion much of the protein is worked upon by microorganisms. This action results in the formation of proteins which can be utilized to advantage by the animal. A number of simple nitrogenous compounds may also be used in this way, thus showing that it is not necessary to supply the ruminant with nutritionally complete proteins. This explains why such good results were obtained with high-protein corn as a feed.

In trials with dairy cows a day's feeding of 42 pounds of Illinois High-protein silage provided 0.5 pound more protein than the same quantity of standard silage. No protein supplement was included in the grain mixture fed the cows which received Illinois High-protein silage while with standard silage 250 pounds of soybean meal were included in each ton of grain mixture. Equal amounts of milk were produced regardless of ration.

High-protein corn grain containing 12.7% protein together with oats and minerals formed a grain mixture which was compared with a grain mixture which included soybean meal and contained 15% protein. Milk yields of both groups averaged 44.3 pounds of 4% milk daily over a period of 10 weeks.

Results with beef steers were similar to those with dairy cows. Yearling steers fed corn containing 13.2% protein together with corn silage required 82 pounds less of shelled corn and 263 pounds less of silage per hundred pounds gain than steers fed standard corn and corn silage. In another test yearling steers fed high-protein corn silage and high-protein corn grain (3.1 and 14.4% protein, respectively) had better appearance and finish than a comparable lot of steers fed silage and grain from standard corn (2.4 and 9.1% protein, respectively) plus soybean meal. In a third test with steers high-protein corn grain was compared with standard corn plus soybean meal when alfalfa hay was the roughage fed. The high-protein corn nearly replaced the protein of a pound of soybean meal fed daily per steer.

Tests with steers showed the digestibility of the protein of high-protein corn to be high. The figure obtained for apparent digestibility of the protein of Illinois High-protein silage was 60% while that for U. S. 13 silage was 48%.

High-protein Corn Also Good for Lambs

Lambs fed either of two kinds of corn grain (containing 11% and 13% protein) made significantly greater liveweight gains than a comparable group of lambs fed low-protein corn (containing 7% protein). This is additional evidence that ruminants are able to utilize the protein of high-protein corn even though chemical tests have shown that this protein is not nutritionally well balanced. With such nonruminants as the young, growing pig, however, the story is different.

Pigs Need Well-balanced Protein

In several trials with growing pigs no significant differences were found between the nutritive values of high-protein and low-protein corn when these were included in rations fortified with minerals and vitamins and brought up to a 15% protein level (12% after the pigs reached 100 pounds in weight) by the addition of protein supplement. Less protein supplement, of course, was needed when high-protein corn was fed. The trials led to the conclusion that satisfactory growth in pigs fed corn rations is possible only when high-protein corn, as well as low-protein corn, is adequately supplemented with amino acids, minerals, and vitamins.

High-protein Corn Has Good Future

Field tests have shown the possibility of producing large amounts of protein per acre by growing high-protein corn. An ample amount of available plant food in the soil is a prime requisite in

order that the maximum protein content of a particular kind of corn be reached.

Strains of corn especially high in protein content show much promise as good producers of grain and forage. Yields of strains tested in the trials here reported did not equal those of adapted grain hybrids, but judging from the past accomplishments of corn breeders, it is highly probable that the yield characteristic can be improved. It is possible that in the Illinois field trials not enough nitrogen and perhaps other plant-food elements were applied to permit the high-protein strains to reach their full yield and protein content. This was indicated by a premature firing of the leaves of Illinois High-protein.

High-protein corn has proved to be a satisfactory means of supplying increased amounts of protein to dairy cows, fattening cattle, and sheep. When properly supplemented, it is also a good source of protein for pigs. For all of these classes of livestock it replaces a part of the protein usually purchased in supplements and thus is a means of reducing the cash outlay for feed. High-protein corn appears to have a good future.

Before you plan to grow high-protein corn, please be advised that this development is still in the experimental stage. So far as the author is aware, no high-protein corn hybrids have been released for commercial production. Several corn companies are working on the project, however, and it is hoped that reader interest will stimulate them to rapid progress and the early availability of this valuable type of corn.

Rootstock Influence . . .

(*From page* 14)

citrus trees in the University of California at Los Angeles orchard. Sour orange scion on sour orange rootstock gives leaves with the lowest potassium content in the orchard. Rough lemon is essentially the same. On the other hand, grapefruit leaves on sour orange rootstock are intermediate in content of potassium, as is sour orange on grapefruit rootstock. The relationships then are reciprocal. Some of the data indicating similar effects of stock and of scion are in Table VII. A careful study of cation exchange capacity of roots and of root respiration indicated that the scion species did not have any influence on either characteristic, so that these cannot explain the behavior described. We must look elsewhere for the answers.

It was of much interest to observe that very young orange leaves did not have the specific rootstock characteristic expressed in composition of mineral elements. These are indicated in Table VI. A possible explanation for this is that new leaves do not derive their nutrients directly from the soil via roots but instead receive them by translocation from other plant parts. The amount of translocation therefore must be related inherently to the scion species rather than the mineral composition of the different plant parts.

Solution Culture Different

Several experiments have been conducted in the glasshouse in solution culture to further evaluate the characteristics of rootstock on mineral nutrition of citrus plants. The potassium, calcium, and magnesium patterns observed in the trees grown in the field were not observed on any trees grown in standard solution cultures. In studies using radioisotopes, however, in solutions of very dilute concentrations there was some relationship between calcium and potassium absorption and the cation exchange capacity of roots (16). For these studies, however, the relationships obtained for potassium were the recip-

TABLE VI.—RATIOS OF PAIRS OF ROOT CATION EXCHANGE CAPACITY AND OF POTASSIUM AND MAGNESIUM CONTENTS OF 2½-MONTH-OLD LEAVES FROM 26-YEAR-OLD TREES ON DIFFERENT ROOTSTOCKS. THESE DATA FOR RELATIVELY YOUNG LEAVES INDICATE THAT THE RATIOS FOR MAGNESIUM MIGHT BE RELATED TO THE SQUARE ROOT OF THE CATION EXCHANGE CAPACITY RATIO.

Rootstocks compared	$\frac{CEC_1}{CEC_2}$	$\frac{K_2}{K_1}$	$\frac{Mg_1}{Mg_2}$	$\left(\frac{Mg_1}{Mg_2}\right)^2$
		Rough lemon scion		
Sweet orange Rough lemon	0.77	0.74	1.00	1.00
Sweet orange Grapefruit	1.11	1.01	1.24	1.54
Rough lemon Grapefruit	1.43	1.36	1.24	1.54
		Grapefruit scion		
Sweet orange Rough lemon	0.77	0.66	.95	.91
Sweet orange Grapefruit	1.11	1.02	1.12	1.25
Rough lemon Grapefruit	1.43	1.55	1.18	1.51
		Valencia orange scion		
Sweet orange Rough lemon	0.77	0.71	0.86	.74
Sweet orange Grapefruit	1.11	1.15	0.90	.81
Rough lemon Grapefruit	1.43	1.61	1.05	1.10
		Mandarin scion		
Sweet orange Rough lemon	0.77	.84	.75	.55
Sweet orange Grapefruit	1.11	1.28	1.06	1.12
Rough lemon Grapefruit	1.43	1.53	1.41	1.98
Average	1.10	1.12	1.07	1.17

rocal of those obtained for plants grown in soil. This requires additional investigation and may help elucidate the relationship of nutrition of plants grown in solution culture and those grown out in the field. For plants grown in solution culture there was a closer relationship of phosphorus nutrition with plants grown in the field than for the other plant nutrients.

The citrus rootstock influence on mineral nutrition is not unlike that of some other tree or bush species that are grafted to other rootstock species (5, 13). Specific rootstock species are often taken advantage of in preventing certain nutrient deficiencies. The observations given in this report undoubtedly will have widespread applications to other tree species and also to comparisons with different field crops. For these reasons their study in this laboratory is being intensified.

Potassium—Fruit Size—Water

Potassium nutrition of citrus trees in southern California has been considered of great importance in recent years because of its relationship to citrus fruit size (14). For this reason the cation nutrition of citrus is being intensively evaluated. A point that perhaps should not be overlooked is potassium-water relationships. The older literature on the function of potassium as a plant nutrient indicated that a function of potassium nutrition was water economy (12). If that is true, then potassium might have an influence on citrus fruit size in years of water stress by its influence on water economy. The rootstock species then would be of considerable importance in this relationship. This aspect also needs further consideration in citrus nutrition.

Summary

Citrus rootstocks have the ability to impose a different pattern of mineral nutrition upon leaves of the scion species. This ability appears to be related in part to the cation exchange capacity of root surfaces. The relationships between pairs of species for the potassium, calcium, magnesium contents of citrus leaves were expressed as

TABLE VII.—POTASSIUM CONTENT OF SIX-MONTH-OLD LEAVES OF VARIOUS SCION SPECIES EACHBUDDED TO SEVEN DIFFERENT ROOTSTOCK SPECIES ILLUSTRATING ROOTSTOCK INFLUENCE AND ALSO THAT THE SCION HAS AN IDENTICAL INFLUENCE ON LEAF POTASSIUM. CATION EXCHANGE CAPACITY OF ROOTS CANNOT EXPLAIN THIS.

Rootstock	Scion				
	Per cent of Potassium				
	Rough lemon	Valencia orange (sweet o.)	Marsh grapefruit	Mean of seven scions*	L.S.D. of means (at .05)
Rough lemon	0.93	1.14	1.24	1.03	.....
Sweet orange	1.29	1.54	1.63	1.38	0.21
Grapefruit	1.47	1.63	2.24	1.65	.....
Mean of five rootstocks*	1.18	1.34	1.64	.....	.....

L.S.D. of means at .05 is 0.25.

a mathematical equation. The exact method for expressing the magnesium is as yet somewhat obscure. This relationship is related to the physical-chemical phenomenon of Donnan equilibrium. Several difficulties encountered in generalizing the relationships were described. Although an equation for the cation relationships explains them especially well, there are other factors that must be considered in completely understanding differential nutrient absorption by plant species.

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TABLE VIII.—INORGANIC COMPOSITION OF LEAVES FROM 21-YEAR-OLD VALENCIA ORANGE TREES COLLECTED AT THREE DIFFERENT AGES AND GROWN UPON FOUR DIFFERENT ROOTSTOCK SPECIES, INDICATING THAT VERY YOUNG LEAVES ARE NOT SUBJECT TO THE ROOTSTOCK INFLUENCE.*

Rootstock	Age of leaves (months)	K	Ca	Mg	N	P
Rough lemon	¼	1.41	1.87	0.27	3.51	0.378
	6	1.14	3.75	0.26	2.92	0.120
	12	0.73	4.43	0.22	2.40	0.088
Sweet orange	¼	1.50	1.87	0.25	3.54	0.370
	6	1.54	3.67	0.22	2.94	0.136
	12	1.18	4.18	0.19	2.57	0.101
Trifoliate orange	¼	1.55	2.15	0.28	3.58	0.365
	6	1.21	4.18	0.24	2.71	0.120
	12	0.99	5.03	0.24	2.50	0.104
Grapefruit	¼	1.52	2.47	0.22	3.21	0.313
	6	1.63	3.92	0.17	2.95	0.127
	12	1.24	4.86	0.14	2.44	0.098

* All values are per cent of dry matter.

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Zinc Deficiency in Corn . . .

(*From page* 25)

eral factors. (1) Availability of zinc may be greater in the subsoil below the limed layer of higher pH. Subsoil samples taken from fields in which zinc deficiencies have been observed on corn had pH values considerably lower than surface samples. Usually the subsoil pH was below 6.0. When the corn roots reach the more acid subsoil layer, they may be able to obtain adequate supplies of zinc for normal growth. (2) Another possibility is that root activity and root numbers increase as the corn plant develops and thus permit the uptake of greater quantities of zinc from the soil. (3) As the season progresses and the soil becomes warmer, organic matter decay by microorganisms increases, with release of any zinc it contains and with formation of carbonic and other organic acids which may increase availability of soil zinc to plants.

The following observation suggests the possible importance of root extension below the plow layer in relation to spontaneous recovery of corn from zinc deficiency. In all field plot work, uniform liberal applications of nitrogen and potassium were made to all treatments of the experiment. It was possible to compare corn growth on the no-zinc plots with that of the adjacent corn as fertilized by the farmer. In many cases, the growth on the experimental check plot was superior to that in the farmer's field, reflecting the lower fertilization rate used by the farmer.

Usually in these cases where zinc deficiency was not extreme the experimental check-plot corn grew out of the deficiency. The farmer's adjacent corn

either grew out of the deficiency later than did the experimental check plot, or failed to show significant recovery.

At the present time, zinc deficiency cannot be considered a major problem in Tennessee, and not many farmers, according to our present information, would benefit appreciably by the use of zinc as a fertilizer material. Further development of zinc deficiency on Tennessee farms might well be minimized by judicious use of lime and fertilizer, taking care to avoid an excess of any nutrient over and above what is needed for optimum yield of the crop being produced. Apparently such caution is particularly important on soils which are extremely high naturally in such a nutrient as phosphate. Under these conditions, liming must be moderate and preferably use made of dolomitic materials. Good rotations, which help maintain organic matter levels, along with optimum levels of potassium, calcium, and magnesium, may well become more and more important as we attempt to reach high yield levels of all crops.

Further studies of the problem of zinc fertilization in Tennessee are desirable, and plans already have been made for their initiation. These studies include an evaluation of the residual effects of a single zinc application, the rates of zinc needed for broadcast application to forage and grain crops, and the evaluation of insoluble sources of zinc.

A New Day in Peanut Production

(*From page* 8)

During 1953 and 1954 the seed stocks were increased, and not until 1955 were there appreciable supplies of seed available. These varieties have been found to yield approximately 15% more than existing farmer stock peanuts. Furthermore, due to their better quality, they have been generally sold for a higher price per pound, giving a return of 20-25% more than existing varieties. Although the effects of these varieties are not reflected in the increased yields shown in Figure 1, they should afford very substantial increases in returns to peanut growers in 1955 and later years as seed supplies are increased (Figure 2).

An extensive peanut breeding program is being continued and should make further contributions. Several lines which appear to be superior to either of the two earlier varieties are already in advanced tests. Attention is being directed to the development of varieties resistant to the more common peanut diseases.

Fertilization. Opportunities exist for increased production through better fertilization practices. Despite increased fertilization of peanut rotations, soil test summaries indicate that approximately two thirds of the soils in the peanut-growing region are low or very low in potash and are in need of heavier fertilization. With increased production, peanuts can be expected to further deplete the level of soil potash. Further increases in production as well as the maintenance of present yield levels are dependent upon fertilization to maintain adequate levels of soil potash. Efforts should be made to build up the level of potash in the soil by heavier than normal fertilization of crops preceding peanuts in the rotation. Where this is not done the potash should be applied directly to peanuts.

Calcium is well recognized as being extremely important in the production of the large seeded type peanut, and a majority of growers are supplying adequate calcium through the use of lime and land plaster (gypsum). Full benefit from land plaster is sometimes not obtained, however, due to late and uneven distribution. To be effective this material should be applied as the

Fig. 4. The conventional method of stacking peanuts for curing (left) requires large amounts of hand labor. Research is being directed towards the development of machines such as the one on the right which picks up and threshes peanuts from a windrow after partial drying.

plants begin to bloom (around the first of July) and should be well distributed throughout the "pegging" zone. Although many growers follow a good liming program, some are attempting to grow peanuts on soil that is too acid, while others have been too zealous in liming and have raised the pH too high. Soil tests should be used to determine lime needs.

Rotations. Rotations have long been considered important in a sound peanut production program. However, very little conclusive information has been available to guide growers in planning the most efficient cropping sequences. In 1952 an extensive series of rotation studies was initiated at the newly acquired Peanut Research Station at Lewiston. These experiments involved peanuts grown continuously, and in two-, three-, and four-year rotations with all the major crops produced in the peanut belt. With appropriate sub-plot treatments, information on the fertilization needs of these different cropping sequences as well as their influence upon insects, diseases, and nematodes is being gathered.

Studies of the effect of cover crops in peanut rotations and the value of returning the peanut hay to the soil are also being made. These studies have already yielded very valuable information. For example, yield differences of from 1,000-1,500 pounds of peanuts per acre have been observed as the result of different cropping sequences. We may expect these studies to provide the basis for better rotation and management sytems in the future (Figure 3).

Insects and Diseases. Many growers are doing a satisfactory job of controlling leaf spot by using sulfur or copper-sulfur dust. Although southern stem rot or wilt is still a serious problem, the prospect of resistant varieties along with chemical control looks promising.

In the last four or five years nematodes have become recognized for the first time as a very serious pest in peanuts. Research now under way suggests that effective control can be attained through proper rotations. Chemicals, though relatively expensive, can be used when it is not feasible to follow a specified rotation. Very significant yield increases may be expected in many areas through the control of nematodes.

Southern corn root worm and other soil-borne pests may be very destructive in some areas. Satisfactory control has been obtained, however, through the application of certain insecticides, and many growers could benefit from their use.

Mechanization. Next to tobacco, the peanut is our least mechanized field crop. This is particularly true of the harvesting operation where peanuts are still picked up by hand and stacked around poles to facilitate drying. A threshing operation follows where, again, considerable hand labor is involved—hauling the stacks to the picker, feeding the vines into the machine, filling bags, forking the hay into a baler, etc. Much research has gone into the development of machinery which might greatly reduce such hand labor. A "once-over" operation where the peanuts are dug, picked from the vines, placed in sacks, and dried with artificial heat has long intrigued agricultural engineers. An intermediate procedure where peanuts are dug and windrowed to allow partial drying is also being studied (Figure 4). The peanuts are taken from the windrow with a pick-up attachment on a conventional picker as it is pulled through the field. This latter practice is already being used in some of the Southern States where weather conditions are more favorable for drying in the field. All of this work is very promising and should lead in a very few years to more completely mechanized and efficient production programs for peanut growers.

A New Day

Over-all increases in peanut production during the past four years have demonstrated the value of improved practices developed through earlier research. Continuing research programs may be expected to pave the way for still further advances.

Many farmers have already produced yields in excess of 4,000 pounds per acre, and this year there is being organized a "Two-ton Peanut Club" to recognize such outstanding performance. Surely we are experiencing a "New Day" in peanut production.

Rambling at Random

(*From page* 5)

soared, the scramble was hectic, and in 1820 Merino wool brought over a dollar per pound. Then suddenly in three or four years the demand for fine wool slumped and the current price fell to 55 cents. Thereupon there was just as big a retreat. It was so bad that one historian claims that some farmers actually turned their Merinos loose and drove them away from the farm. Butchers slaughtered heaps of them. One drover said that he acquired a whole flock for less than $50, whereas the ram heading it once brought $1,000 at a sale.

You could say with real truth that not over 30 years ago we of this era also had a big bulge in cattle and hogs sold for breeding purposes, and auction sales were guilty of forcing prices to dizzy dimensions. The animal husbandry folks could do little then to halt the panic for progressive breeding, but it was one angle of the general hysteria in the decade before the acute depression.

Next in scope and pressure to the old Merino craze of bygone times was the silk mania. Here the farmer was to become wealthy by planting and propagating the Chinese mulbery tree, on which the silkworms were to gnaw the road to opulence for the operators. Seems to me we had a similar silk craze only a few years ago. Newspapers and magazines carried reams of copy and advertising that pushed interest to fever heat and sent prices for trees sky-high. The raving devotees of the mulberry mania bought and sold the buds and cuttings. Few folks ever actually produced any silk, nor had any facts been disseminated about the length of time and the soil and climate suited to Chinese mulberries, or the labor charges to be reckoned before

the neat profits would fill the hope chests waiting in many rural homesteads. Then in 1840 the bottom fell out and carried with it the financial fate of many chance-takers.

Good things came into the picture also, things well enough suited to progressive farming, but they were often overdone and held up to the rural public as bonanzas. Huge bullocks were taken to the current shows and exhibited as the ideal in form and profit. Enormous hogs had their devoted adherents, and among these, the Berkshires suffered temporarily from unwarranted and unwise price pushing. One observer lists Chinese corn and the Rohan potato as other evidences of glutted production and collapsed demand.

Colleges had but a feeble voice and a limited audience in those speculative times, and the farm papers with a few exceptions hated to throw cold water on what might prove to be a sound venture—usually inveighing against crazes when they had assumed terrific heights and got beyond control.

EDMUND Ruffin of the Farmers' Register probably said the most editorially in behalf of sanity and caution. He said that by the united operations of the cheats and their dupes, there was a perpetual succession, in the agricultural and other papers, of agricultural humbugs and deceptions.

"Some new variety of corn or wheat is announced and recommended as being superior in production and value to anything known before. This statement may be partly true, or altogether mistaken, and in either case, the publication may have been made with honest and even praiseworthy intentions," Editor Ruffin wrote.

"The enthusiastic and credulous among the readers of these hugely-wrought panegyrics are all put agog to obtain seeds, which, as represented, alone will add 30 per cent to their crops. The seedsmen hasten to give their orders that they may profit by the new demand—just as milliners would for bonnets of the latest fashion—and knowing well that the fashion will be apt to be as transient in the one case as the other.

"Do not let us be understood as denying all value to these overrated novelties, nor wishing to discourage trials of new plants or supposed new improvements of any kind. On the contrary, we would encourage trials, if made carefully and accurately, as being calculated to amuse and gratify all cultivators of an inquiring mind, and sometimes lead to results which will be of important value to farming." Purveyors of information and recommended practices in those days of pioneer farming had no easy time of it. They tried to be fair and unprejudiced, and to follow the ancient saw: "Be not the first by whom the new is tried, nor yet the last to lay the old aside."

Only a week or so ago, I found an authoratative editorial slant on this very question. It appeared in the "Southern Planter" and was written by the late and revered Frank Hamilton Jeter—who in his constant service to planters of the South bears many of the same imperishable traits as we ascribe to that early-day soil-builder, Edmund Ruffin. It was possibly the last of a series of articles ever written by Dr. Jeter through a period of almost 40 years for the Richmond journal.

"Blessed are they who try something new. It may be a help to them. This is one way an enthusaistic farm agent describes those forward-looking farmers with whom he is privileged to work. Such persons are found in North Carolina with increasing regularity as the cost of farm operations continue to climb while take-home money from such operations remains stationary or actually declines.

"It is easy to understand the doubt and fear of a person who uses a new agricultural practice for the first time, and who must invest some of his avail-

able money or credit to that practice," he concluded.

Despite the advances in science and communications, we have thousands of fairly successful farmers on small places who have never tried alfalfa, hybrid corn, antibiotics and minerals in feeds, soil tests and fertilizers, seeding legumes in wide-row cornfields, artificial insemination of cattle, electric lights for laying flocks, and weed eradication with chemicals.

Sanctioned as such practices are by experimental studies and featured regularly in farm magazines, there are some who still shy away from things that are new and untried for their own acreages. Yet it is likely that from this group come the farmers who still chase after vague but rosy promises and answer the ads that present extravagant claims.

ONE instance comes to mind along this line. About 30 years ago there was a void left in our scientific findings relative to the proper handling of Bang's disease, often known as "contagious abortion." As a matter of fact, no complete cure has been found to this day—official regulation and private use of accredited vaccines, plus the agglutination test and the Ring herd test, are steps in eradication.

Anyhow, back at the time in question, advertising was widely carried in press and radio about the wonderful merits of a Minnesota "cure" that strangely came from a formula of a rather simple nature containing brown sugar—easy to make and low in manufacturing cost, leaving handsome profits for somebody. As you many recall, it went like wildfire awhile, and a few leading stockmen claimed they had received benefits from its use. Later it became the object of a public inquiry, and today nothing is heard of it. But had we already possessed a remedy for this costly cattle disease to match some of the controls and preventives science has handed to us in other livestock maladies, all this buncombe and frantic investment in useless cures for bovine abortion need not have occurred.

We may need some coordination among our states in regard to research, to stop a lot of contrary recommendations floating around. It's true that experiment stations often disagree about handling much the same situations—but yet, with all that weakness, we can be thankful to have the skill and ability of so many trained men and women tirelessly engaged in finding answers to some of these hard questions.

RETURNING again to days when trial and error were the lot of the farmer, and his vulnerable situation made him run after the glittering mirages of easy wealth, let's take note of a short piece written in 1878.

Georgia's commissioner of agriculture then was Thomas P. Janes, A.M. Mr. Janes had a preface to his annual report to the governor, which ran this way:

"There has long existed among practical farmers a prejudice against the application of science to practical agriculture. But today this prejudice has not only been to a large extent overcome, but there is manifest a thirst for a knowledge of science as related to agriculture. There is a spirit of inquiry among Georgia farmers manifested in the number of questions we receive.

"The object of science is to ascertain what the natural laws are and to learn from nature by the interpretation of those laws, the will and mode of thought of the Creator, as expressed in the physical world.

"Science has the same relation to the physical world that theology does to the spiritual. One interprets God's will, expressed in His creation; the other, His will as unfolded in revelations. Agricultural experiments, therefore, have for their object the interpretation of God's will in relation to plant and animal life and nutrition."

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SOYBEAN SEED PROTECTANT

Last year's drought, in many areas, left soybeans vulnerable—with the usual protective coat now fragile and an easy prey to fungus.

Wise growers take no chances! They spray with Spergon.

Spergon not only is an excellent fungicide—it also puts a lubricant coating on the bean, for less seed breakage, easier planting. Spergon is the best preventative of spotty emergence, weak stands, lower yields caused by damp planting weather.

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FREE LOAN OF EDUCATIONAL FILMS

The American Potash Institute will be pleased to loan to educational organizations, agricultural advisory groups, responsible farm associations, and members of the fertilizer trade the motion pictures listed below. This service is free except for shipping charges.

FILMS (ALL 16 MM. AND IN COLOR)

The Plant Speaks Thru Deficiency Symptoms (Sound, running time 25 min. on 800-ft. reel.)

The Plant Speaks, Soil Tests Tell Us Why (Sound, running time 10 min. on 400-ft. reel.)

The plant Speaks Thru Tissue Tests (Sound, running time 14 min. on 400-ft. reel.)

The plant Speaks Thru Leaf Analysis (Sound, running time 18 min. on 800-ft. reel.)

Save That Soil (Sound, running time 28 min. on 1200-ft. reel.)

Borax From Desert to Farm (Sound, running time 25 min. on 1200-ft. reel.)

Potash Production in America (Sound, running time 25 min. on 800-ft. reel.)

In the Clover (Sound, running time 25 min. on 800-ft. reel.)

In Canada: The Plant Speaks Thru Deficiency Symptoms
The Plant Speaks, Soil Tests Tell Us Why
The Plant Speaks Thru Tissue Tests
The Plant Speaks Thru Leaf Analysis
Borax From Desert to Farm
Potash Production in America

DISTRIBUTORS

Northeast: Educational Film Library, Syracuse University, Syracuse 10, N. Y.

Southeast: Vocational Film Library, Department of Agricultural Education North Carolina State College, Raleigh, North Carolina.

Lower Mississippi Valley and Southwest: Bureau of Film Service, Department of Educational Extension, Oklahoma A & M College, Stillwater, Oklahoma.

Midwest: Visual Aid Service, University Extension, University of Illinois, Champaign, Illinois.

West: Department of Visual Education, University of California, Berkeley 4, California.

Department of Visual Education, Uiversity of California Extension, 405 Hilgard Ave., Los Angeles 24, California.

Department of Visual Instruction, Oregon State College, Corvallis, Oregon.

Bureau of Visual Teaching, State College of Washington, Pullman, Washington.

Canada: National Film Board, Ottawa, Ontario.

For the Province of Ontario: Distribution Services, Ontario Agricultural College, Guelph, Ontario.

IMPORTANT

Requests should be made well in advance and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of loan.

Request bookings from your nearest distributor.

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

Reprints

28-12-45 Better Corn (Midwest) (Circular)
F-3-40 When Fertilizing, Consider Plant-food Content of Crops
S-5-40 What is the Matter with Your Soil?
Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
A-1-44 What's in That Fertilizer Bag?
P-3-45 Balanced Fertility in the Orchard
Z-5-45 Alfalfa—The Aristocrat
OO-8-45 Potash Fertilizers Are Needed on Many Midwestern Farms
ZZ-11-45 First Things First in Soil Fertility
T-4-46 Potash Losses on the Dairy Farm
Y-5-46 Learn Hunger Signs of Crops
TT-11-47 How Different Plant Nutrients Influence Plant Growth
VV-11-47 Are Your Pasture Conscious?
X-6-48 Applying Fertilizers in Solution
AA-6-48 The Chemical Composition of Agricultural Potash Salts
GG-10-48 Starved Plants Show Their Hunger
SS-12-49 Fertilizing Vegetable Crops
BB-8-50 Trends in Soil Management of Peach Orchards
X-8-51 Orchard Fertilization Ground and Foliage
BB-10-51 Healthy Plants Must Be Well Nourished
II-12-51 Pasture Improvement With 10-10-10 Fertilizer
KK-12-51 Potassium in Animal Nutrition
A-1-52 Research Points the Way to Higher Levels of Peanut Production
Y-10-52 The Nutrition of Muck Crops
CC-12-52 The Leaf Analysis Approach to Crop Nutrition
I-2-53 Sericea Is a Good Drought Crop
J-3-53 Balanced Nutrition Improves Winter Wheat Root Survival
K-3-53 Kudzu Keeps Growing During Droughts
N-4-53 Coastal Bermuda—A Triple-threat Grass on the Cattleman's Team
P-4-53 Learning How to Make Profits from Sweet Potatoes
T-5-53 Trefoil Is Different
W-6-53 The Development of the American Potash Industry
DD-10-53 Sampling Soils for Chemical Tests
II-11-53 The Importance of Legumes in Dairy Pastures
JJ-11-53 Boron—Importance to Crops
MM-12-53 White Birch Helps Restore Potash-Deficient Forest Soils
K-2-54 Soil and Plant Analysis Increase Fertilizer Efficiency
R-3-54 Soil Fertility (Basis for High Crop Production)
U-4-54 Nutrient Balance Affects Corn Yield and Stalk Strength
CC-6-54 Fertility Increases Efficiency of Soil Moisture
EE-8-54 Red Apples Require Balanced Nutrition
FF-8-54 Apply Fertilizers in Fall For Old Alfalfa, Grass Pasture and Timothy-Brome Fields
GG-8-54 Eect of Boron on Beets and Crops Which Follow
JJ-10-54 Principles Involved in Soil Testing
LL-10-54 Relation of Fertilizer to Quality and Yield of Flue-cured Tobacco
MM-10-54 Longer Life for Ladino
SS-11-54 Foliar Application of Plant Nutrients to Vegetable Crops
VV-12-54 Potassium Affects Growth of Stocks
YY-12-54 Physical Condition of the Soil Affects Fertilizer Utilization
A-1-55 Potash-Deficiency Symptoms
C-1-55 Summary of Ten Years' Work with Complete Fertilizers on Sugar Cane
D-1-55 Nitrogen Use Accentuates Need for Minerals
E-1-55 Guides to the Management of Illinois Soils
F-1-55 The Soil Profile's Contribution to Plant Growth
G-2-55 Seven Steps to Good Cotton
H-2-55 Apparent Fertility Trends in Western Irrigated Soils
I-2-55 Shortages of Potash Limit Grape Yields
J-2-55 Fruit Fertilization in New Jersey
L-3-55 Soybean Production in the Southern States
M-3-55 Possibilities and Limitations of Irrigation in the Southeast
N-3-55 The Pacemaker Club Grwos More Corn
P-3-55 N-P-K for Deciduous Fruit Trees
Q-3-55 Soil Testing Moves Ahead in Arkansas
R-4-55 Potash Prevents "Curl Leaf" of Sour Cherries
S-4-55 Greener Pastures Mean Better Living
T-4-55 Leaf Analysis Reveals Potash Need in Southern Oregon
U-4-55 Fertilizer Recommendations—Burley Tobacco
V-4-55 Planned Nutrition for Canning Tomatoes
W-5-55 The Production of Sugar Beets on Organic Soils
X-5-55 What Is Happening to Our Citrus Soils?
Y-5-55 Pasture Improvement Through Renovation
Z-5-55 Azalea Fertilization
AA-5-55 Soil Improvement Pays in Large Figures
BB-8-55 Residual Fertility Insures Alfalfa After Drouth
CC-8-55 Plan Before You Fertilize
DD-8-55 A Good Summer Grass Team
EE-10-55 Fertilizing For Better Apples
FF-10-55 Sod Seeding Improves Pastures
GG-10-55 Improved Water-disposal Systems
HH-10-55 Fertilizers Will Cut Production Costs

THE AMERICAN POTASH INSTITUTE

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"Last night," the young chap told his friend, "I had the sweetest girl in my car! When we came to a lonely place I wanted to kiss her, but she said, 'I'd like to see the stars when you kiss me. Why don't you take the top down?' So after working an hour I finally got the top down and . . ."

"An hour?" interrupted his friend. "Why I don't need more than two minutes for that."

"I know," said the first, "but you have a convertible."

* * *

Father: "Now, son, tell me why I punished you?"

Son: "That does it. First you pound the life outa me and now you don't know why you did it."

* * *

Two distillers of moonshine were discussing their operations.

"When I take my stuff into town," one of them explained, "Ah always drives mighty slow—'bout 20 miles per hour."

"Skeered o' the law?" the other jeered.

"Nope," retorted the first. "Gotta age the stuff, hain't ya?"

* * *

"When we were first married I used to wake my husband every morning with a kiss."

"And you still do?"

"Well, no; after a few months he bought an alarm clock."

"Golf is too expensive for me, now," remarked a youngster, "but just as soon as I can afford to lose golf balls, I'm going to take up the game—seriously."

"Let me tell you something, son," responded an old-timer, "by the time you can afford to lose golf balls, you can't hit 'em that far."

* * *

A salesman's phone call to a prospect's home was answered by a small boy.

"Is your mother or father there?" asked the salesman.

The boy answered no.

"Well, is there anyone there I can speak to?"

"My sister," said the boy.

"Good. Put her on."

There was a long period of silence, then the boy's voice came back on the phone.

"I'm sorry, I can't lift her out of the playpen."

* * *

He: "I suppose you dance."

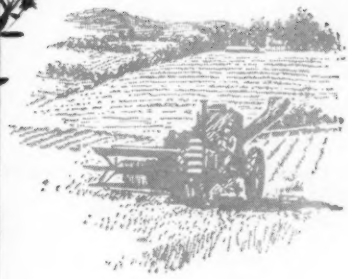
She: "Oh, yes. I love to!"

He: "Great. That's better than dancing."

* * *

Professor (to medical student) "The muscle of this patient's left leg has contracted until it is much shorter than the right; therefore he limps. Now what would you do in such circumstances?"

Student: "I'd limp, too."



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Fertilizer Borate (HIGH GRADE)

can give you an extra ton of Alfalfa hay per acre...

See for yourself what Fertilizer Borate, with its high boron content, meant to this alfalfa field. Boron, so vital to alfalfa, is also required by other field crops such as clover, sweet corn, tobacco... and most vegetable and fruit crops. This year, invest a few extra pennies per acre in Fertilizer Borate... the low-cost fertilizer grade of borax... to grow better crops!

. . . . Look for These Symptoms in Alfalfa: Lack of boron causes plants to become puny and dwarfed. Look for yellow or reddened top leaves, stunted, with growing tips rosetted. See close-up photo.

● *Fertilizer Manufacturers*— ***Here's Borax at the Lowest Cost per Unit... It's Fertilizer Borate-High Grade!***

This sodium borate concentrate, developed especially for the fertilizer trade, has higher analysis... approximately 121% borax equivalent. Choice of fine or coarse mesh.

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